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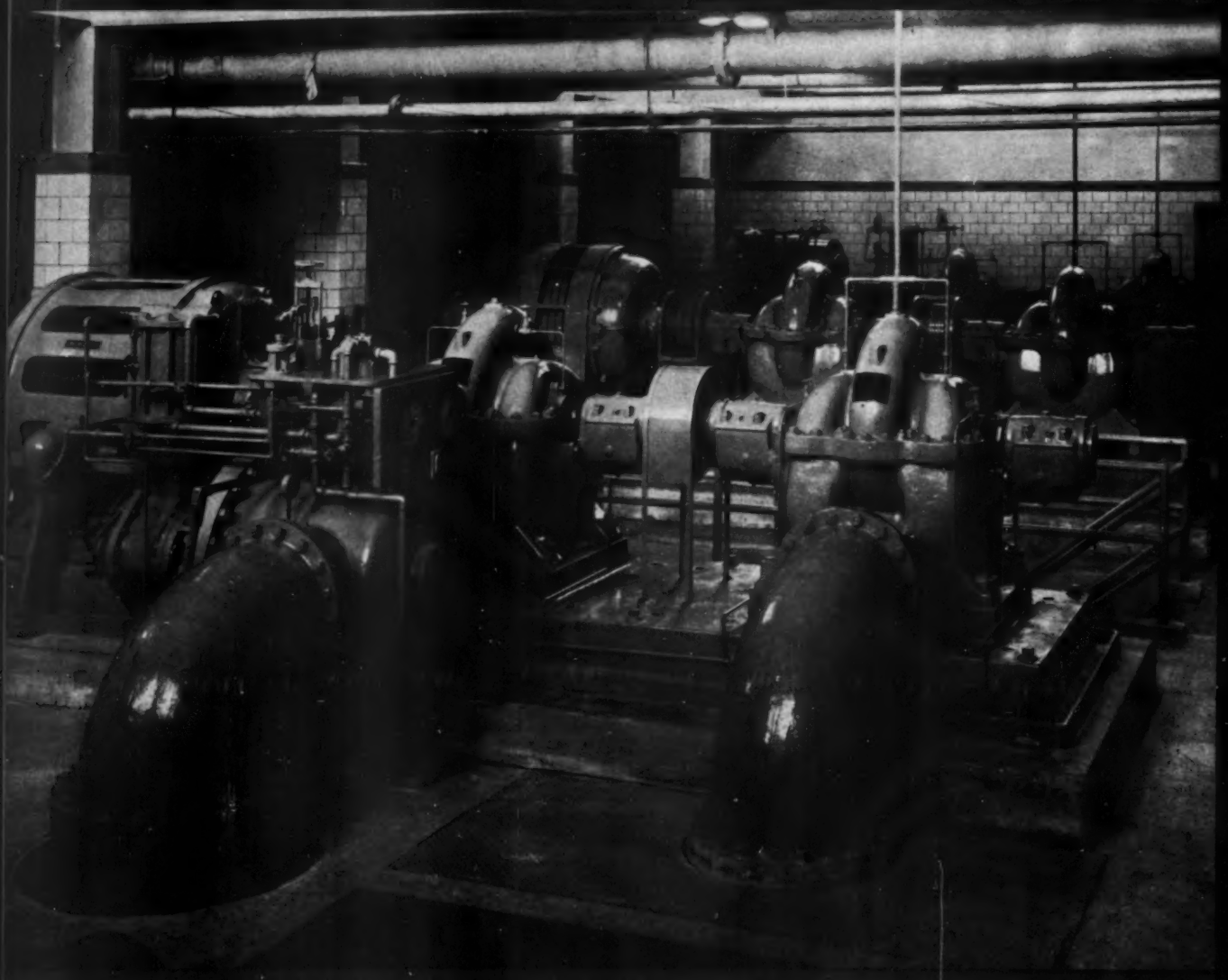
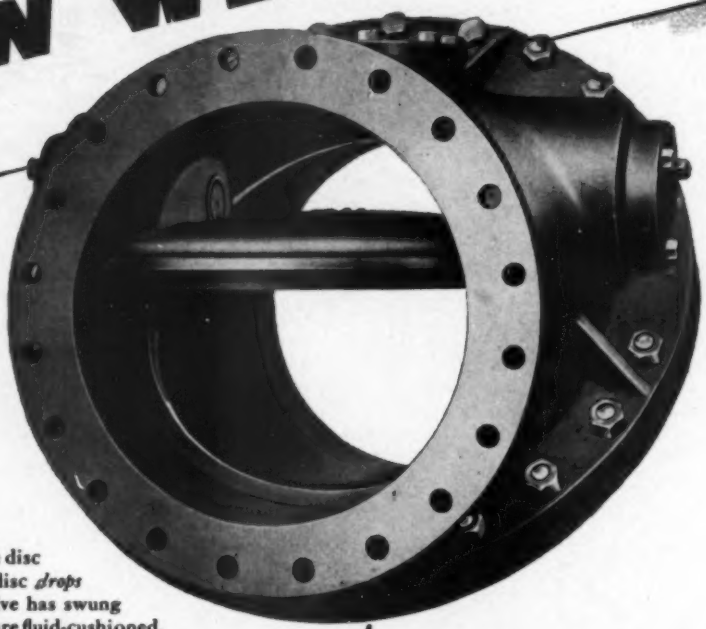
WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL



APRIL, 1954

Only Chapman's *Tilting-Disc* Check Valves Give You...

NO SLAMMING
LOW HEAD LOSS
LOW WEAR



Here's the check valve that stays open with minimum flow resistance, closes fast without slamming, closes tight without sliding or scraping wear.

Cushioned Closing

Pressure against the upper part of the disc cushions it as it closes. Then the disc *drops tight* to its beveled seat after the valve has swung closed. Both actions are fast, but they are fluid-cushioned. Seating is quiet in all but unusual piping arrangements.

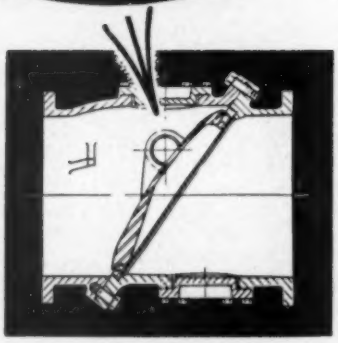
Low Flow Resistance

The streamline design of the valve body and disc eliminate turbulence and cut flow resistance. The fluid holds the disc tightly against its stops, without flutter. The body is larger around the disc, so the net valve area is at least as much as the pipe area.

Minimum Wearing Action

Because the disc *drops* tight, it doesn't slide against the seat. The wear on hinge pins is small because the disc doesn't flutter. Unusually husky construction in every detail means long life under the toughest conditions for Chapman's Tilting Disc Check Valve.

Full engineering and construction data are in Chapman's Catalog #30. Write for it now.



Here's Why CHAPMAN Tilting Disc Check Valves *Keep Quiet* All Their Lives

This specially designed "airfoil" disc balances perfectly in open position... then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

The CHAPMAN VALVE Manufacturing Company

INDIAN ORCHARD, MASSACHUSETTS

WATER AND SEWAGE WORKS. Reg. U. S. Patent Off. Published monthly by Scranton Publishing Co., at 404 North Wesley Ave., Mount Morris, Ill. Entered as second class matter Mar. 4, 1948, at the post office at Mount Morris, Ill., under Act of March 3, 1879. For subscription rates, see Contents Page.

THERE'S NO SAFE SUBSTITUTE . . .

Clay Pipe Sewerage MUST Keep Pace With Every Growing City!

Public officials in the Greater Minneapolis area know how important safe sanitation is to fast-growing new residential areas. This one project alone—the Ardmore addition to the city's southwest borders—calls for 7,892 feet of Clay Pipe. Another $4,000,000 project in the suburb of Richfield will require an estimated 100 miles of Clay Pipe. The Richfield project will be handled by the G. M. Orr Co., consulting engineers, under the supervision of Robert Huston, design engineer.

Throughout the nation, Vitrified Clay Pipe is solving vital sewerage problems of areas confronted with "growing pains." Here are just a few of the reasons for this overwhelming preference for Clay Pipe:

PUBLIC OFFICIALS know that Clay Pipe is guaranteed for 50 years. It's a guarantee of safety and performance that is especially important when sewerage and drainage facilities are financed by bond issues.

ENGINEERS are assured their professional reputations will be enhanced by years of trouble-free service, because Clay Pipe can't be corroded by acid waste or sewer gases.

CONTRACTORS know they can count on Clay Pipe for fast, easy installation and ready availability.

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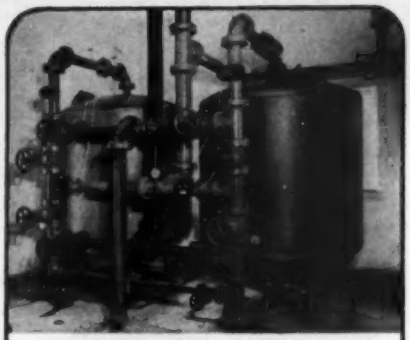
How Martinsville gets iron-free, soft water

Martinsville, Illinois Municipal Water Plant. Constructed in 1950.



Compact Permutit pressure filters have a 150 gpm capacity...remove iron oxidized in coke-tray aerator, reduce turbidity.

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"SEWAGE WORKS PRACTICES" are discussed by *Prof. Don. Bloodgood*

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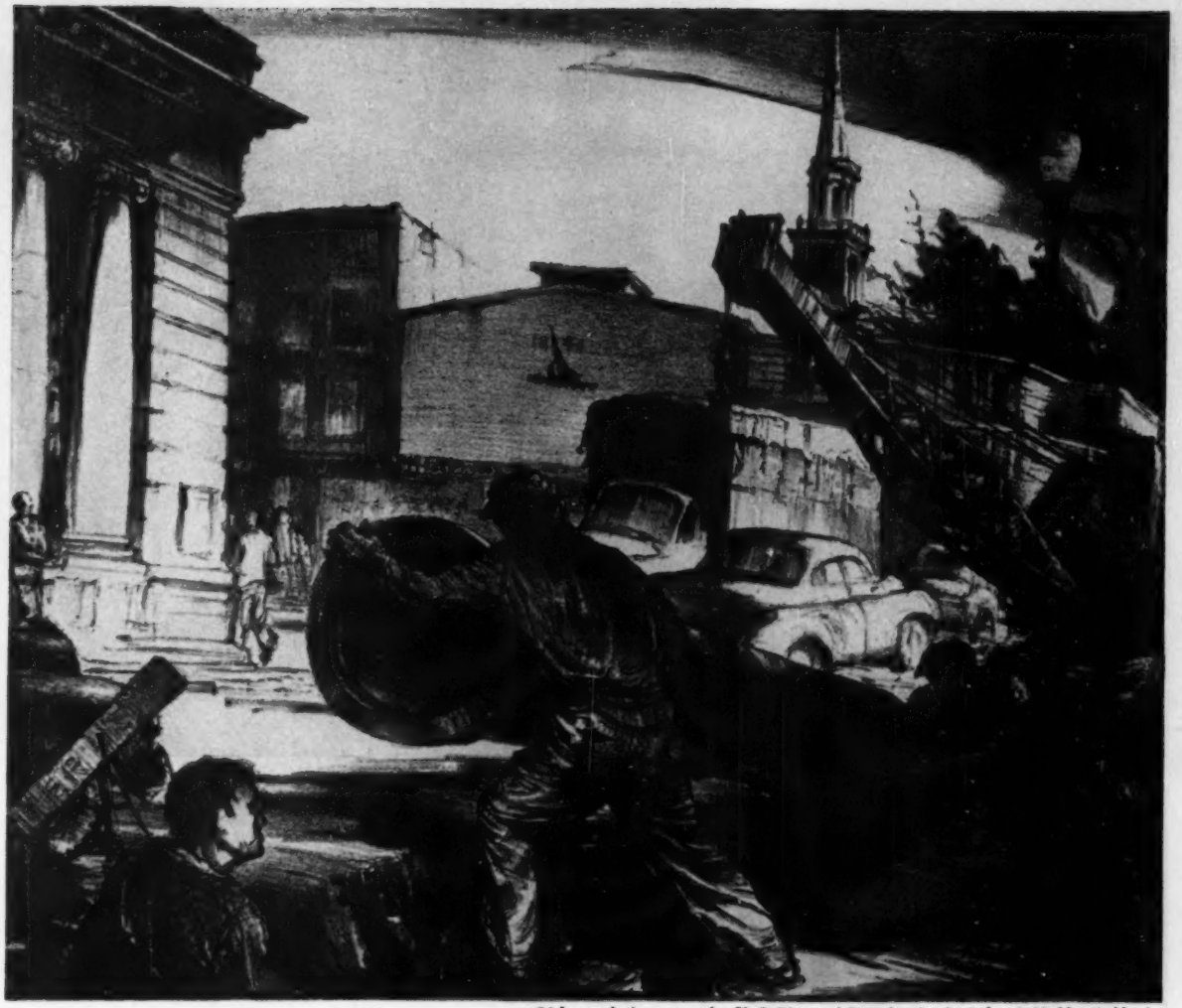

Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

THIS ILLUSTRATION shows the laying of cast iron pipe in the business section of a small town, which could be for water, gas or sewerage service. Such a situation calls for a pipe with proved long life to be placed beneath the costly permanent pavement. Whether in the business district, residential area or the country, cast iron pipe has established an enviable record of low cost per service year.

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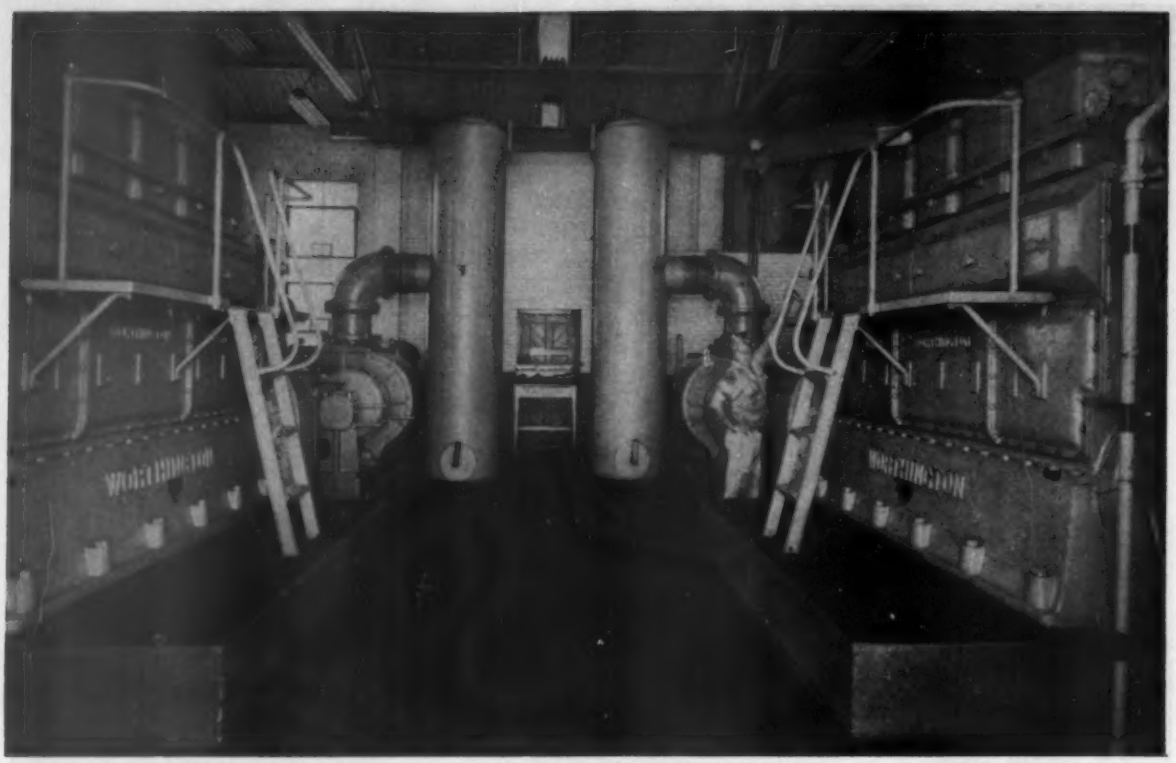
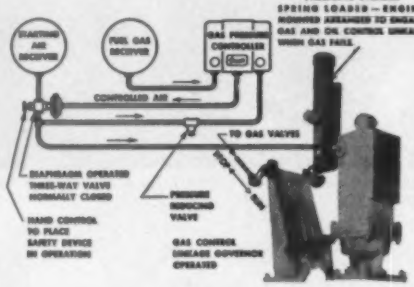


ACTIVATED SLUDGE PLANT in Phoenix, Arizona gets low-cost power from these two Worthington dual-fuel engines which run on sewage gas, using a minimum amount of pilot oil.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GAS PRESSURE CONTROLLER
CONTROLLED AIR
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Sewage gas runs these engines

• In treating sewage, many cities have the help of a receiving stream to provide some purification of the liquid-borne wastes by the diluting action of the water.

Phoenix, Arizona, also has a receiving stream, the Salt River, but gets no beneficial diluting action since the entire flow of the Salt below Phoenix consists of effluent from the sewage treatment plant.

Naturally, a situation like this demands really thorough sewage treatment — and the best in equipment.

To supply the motive power for two large blowers, Phoenix's engineers selected two Worthington dual-fuel engines. And they put their sewage gas to work by using it as fuel for these dependable Worthington engines. You might say that this sewage plant is almost running itself.

Operating records of sewage treatment plants everywhere show that you just can't beat Worthington dual-fuel engines as economical, dependable drives for blowers, pumps and generators. Drop us a line and find out for yourself about Worthington's new "Automatic Fuel Switcher", which automatically changes over to 100% fuel oil when the gas pressure drops below normal.

Worthington Corporation, Engine Division, Section E.3.10, Buffalo, New York.

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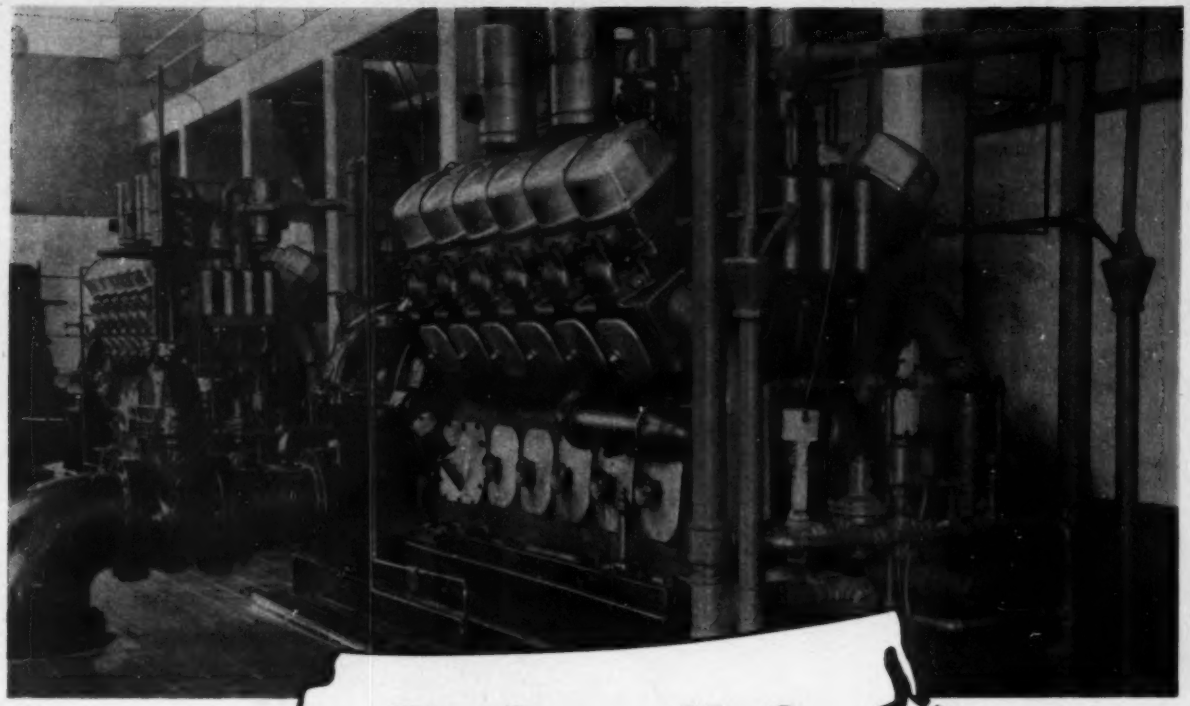

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Here's what officials of Durham did, when they had to scrap their obsolete steam-engine-driven pumps: They replaced them with two modern pumping units that were powered by Le Roi L3460 engines.

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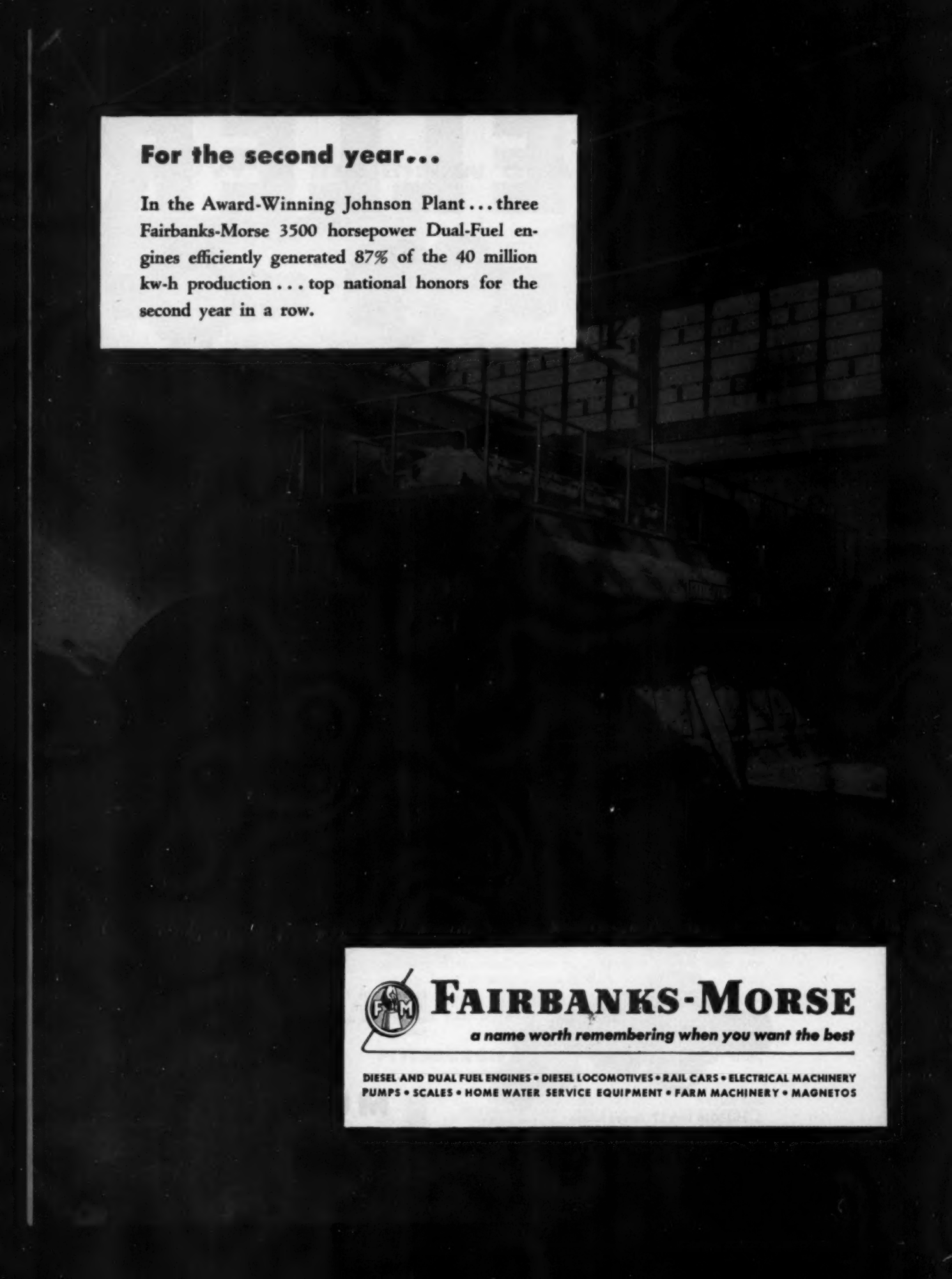

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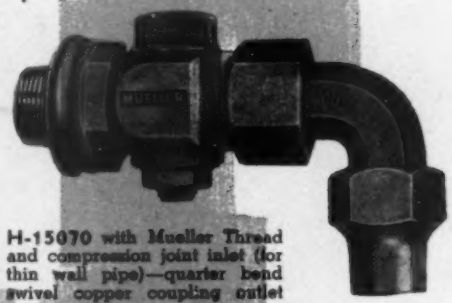

H-15070 with Mueller Thread and compression joint inlet (for thin wall pipe)—quarter bend swivel copper coupling outlet

H-9981 with I.P. thread inlet—increasing I.P. thread outlet with eighth bend coupling for wiped joint

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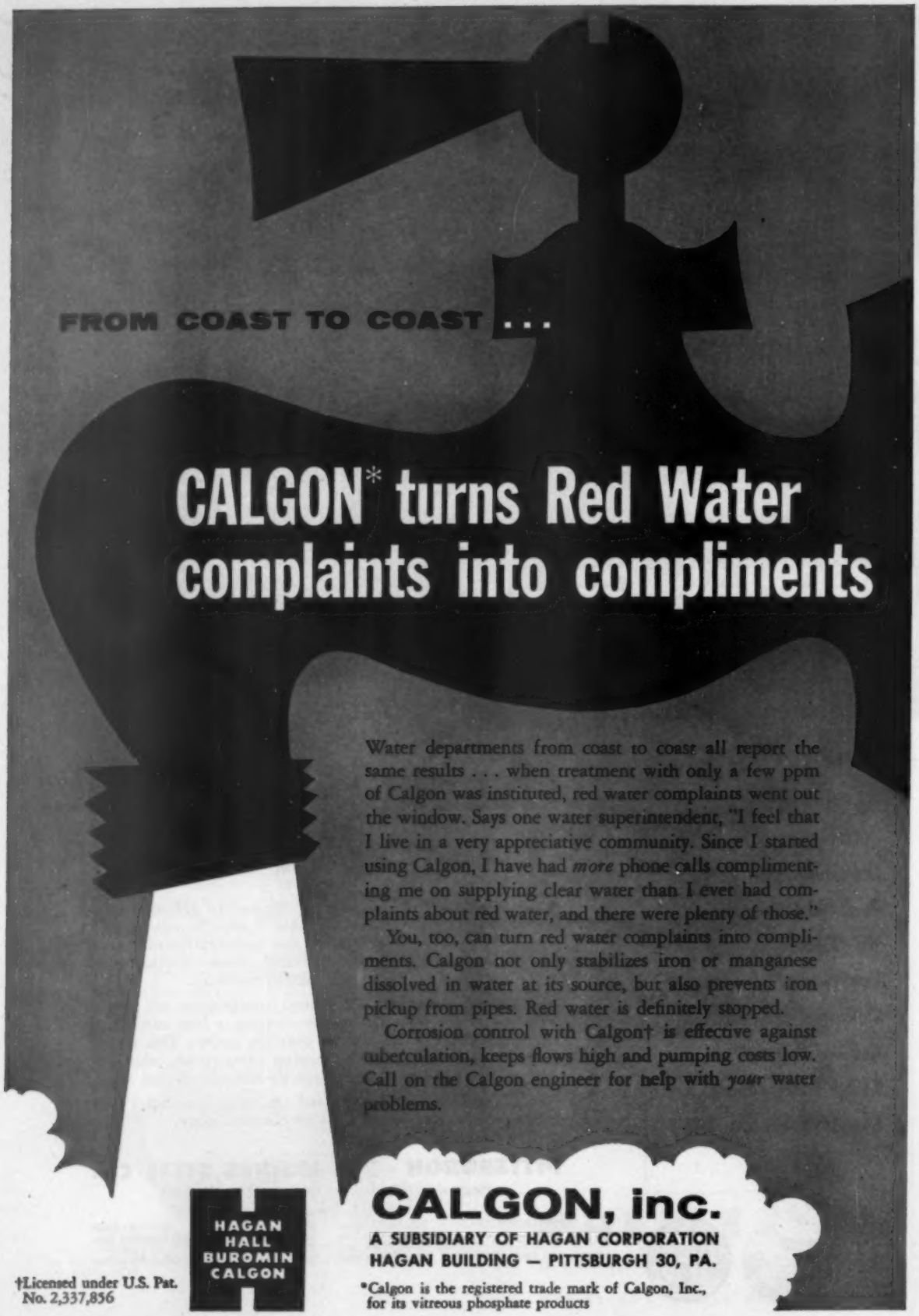
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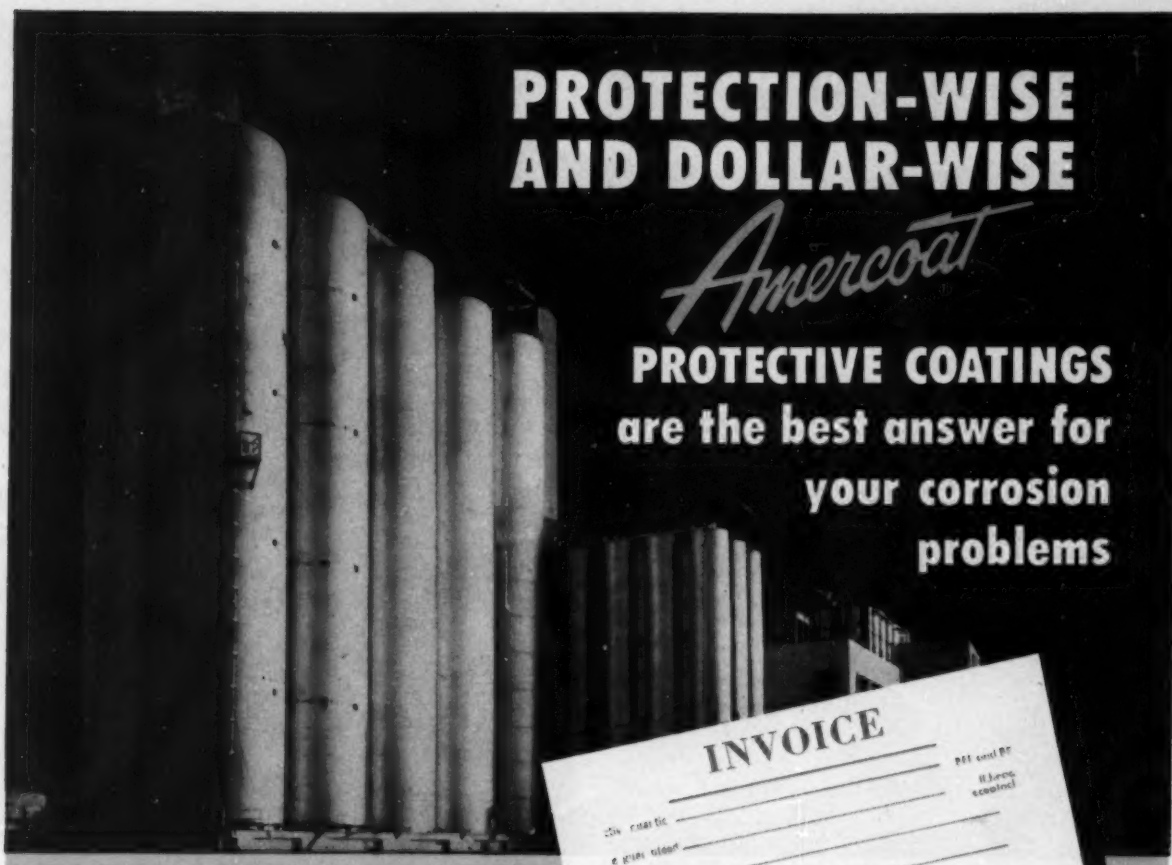

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How to reduce maintenance costs through better coating practices

This valuable guide can help you effect substantial savings on maintenance costs. It lists the vital steps which can often mean the difference between long coating life or early failure. The guide discusses correct coating selection methods, and it thoroughly describes surface preparation and application techniques. Included is a suggested test for evaluating chemical resistance properties of coatings, as well as a checklist of safety precautions. For your free copy write:

Amercoat CORPORATION

Chicago, Illinois • Kenilworth, New Jersey
Jacksonville, Florida • Houston, Texas

Dept. F, 4809 Firestone Blvd., South Gate, California

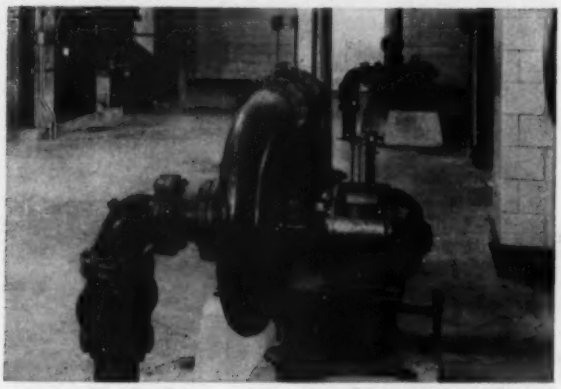
AERIAL VIEW of Baltimore treatment plant shows layout of settling tanks and filters. The plant, serving the Baltimore area, handles an average of 130 mgd. Architect was Lucius R. White; general contractor was the Chesapeake Contractors.

Baltimore's modernized sewage plant

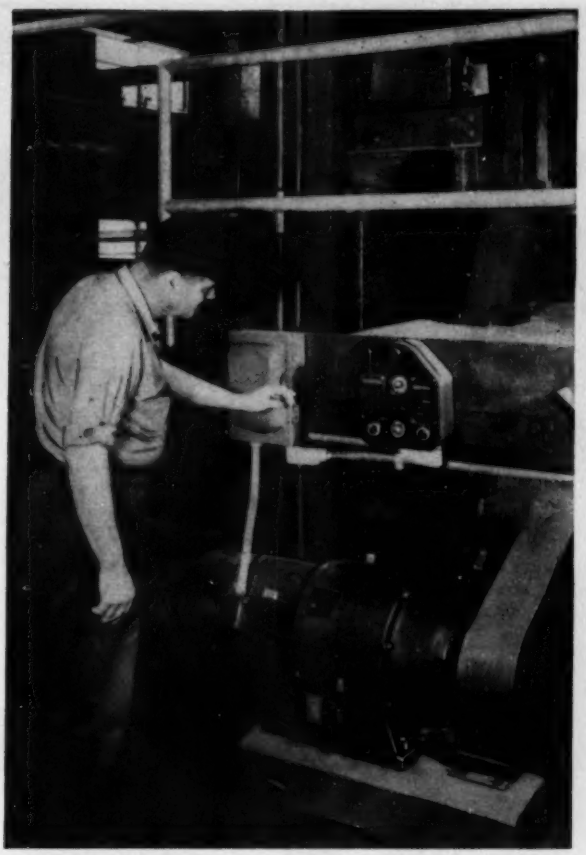
MAIN PROCESS CONTROL panel for the sludge-drying plant is this G-E Cabinetrol* panel. G-E Apparatus Sales engineers helped to plan installation to fit the exact needs of the plant.

*Reg. trade-mark of General Electric Co.

VAPOR FAN, driven by 60-hp G-E motor, removes moist air from cyclone and discharges it into the furnace for drying.



GAS BOOSTER, driven by G-E 7½-hp motor, increases pressure of gas coming from digester tanks for plant utilization.



EFFICIENT DRIVE for the mixer is supplied by this economical, easily maintained 15-hp G-E gear-motor.

brings CLEAN WATERS to Back River

G-E equipped sewage treatment plant expansion completes sludge-drying project for the city

In January, 1953, Baltimore's newly modernized drying plant went into full operation. Owned and operated by the city of Baltimore, it was built to safely handle the city's waste and to help decontaminate the Back River, making it safe for recreation. This one plant handles the major part of the entire Baltimore area.

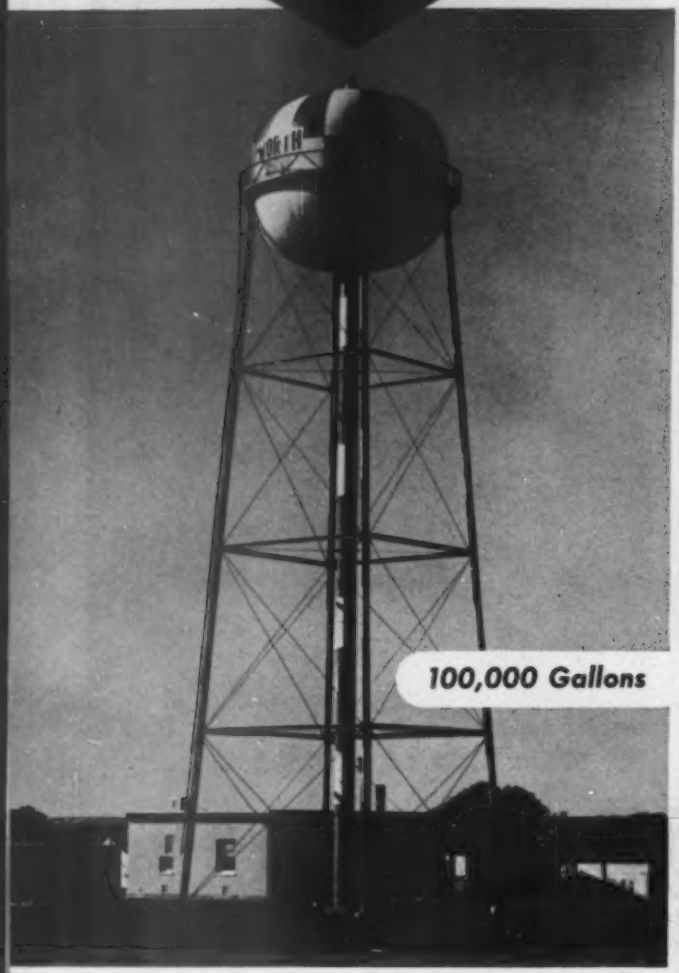
Consulting engineers Whitman, Requardt & Associates and electrical contractor Blumenthal Kahn Electric Co. utilized G-E application engineering aid in specifying and installing the G-E Cabinetrol panel, which controls power distribution of low-voltage power for the drying plant.

SPECIALISTS IN SEWAGE-PLANT ELECTRIFICATION, G-E application engineers are ready to work with *your* engineers and consultants and contractors to help design a co-ordinated electrical system for your new plant or modernization project. Contact your local G-E Apparatus Sales Representative early in the planning stage. And to gain public support for your new sewage facilities, ask him now how you can put the G-E "More Power to America" film, CLEAN WATERS, to work in your community. General Electric Co., Schenectady 5, N. Y. 666-81

Engineered Electrical Systems for Sewage Plants

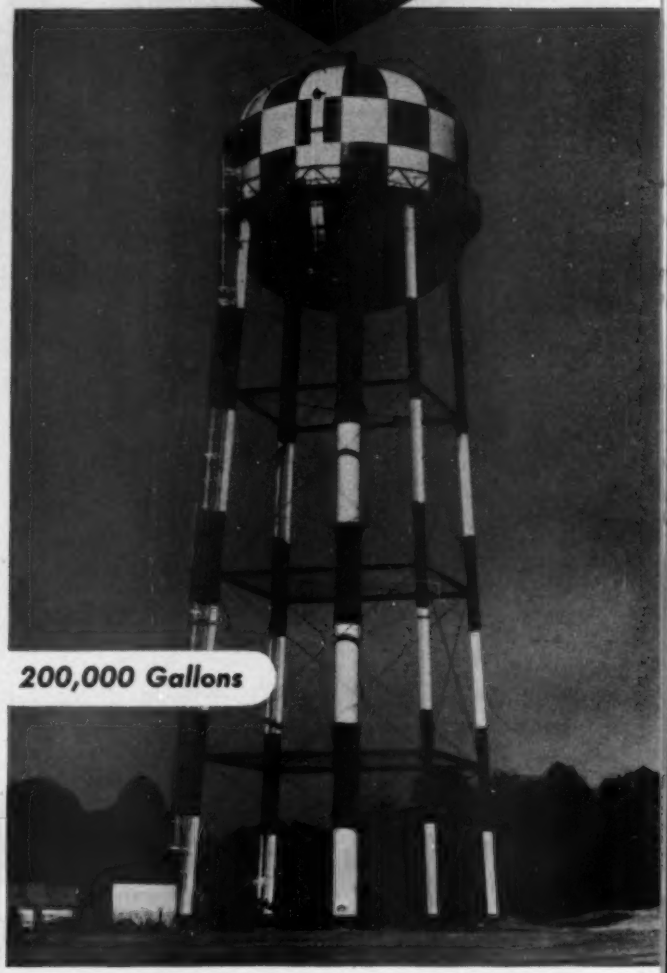
GENERAL ELECTRIC

LAKE WORTH
Texas



100,000 Gallons

LITTLE CREEK
Virginia



200,000 Gallons

Typical Examples of dependable low cost water storage by

PITTSBURGH-DES MOINES

These representative Pittsburgh-Des Moines Elevated Steel Tanks are of our popular Double-Ellipsoidal design, on 100 ft. H-column towers. They provide maximum value in standard construction, meeting a wide range of municipal water storage requirements. Many other PDM elevated tank types are available for special needs, with H-column, box or tubular column towers. Write for our comprehensive Modern Water Storage brochure.

PITTSBURGH-DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

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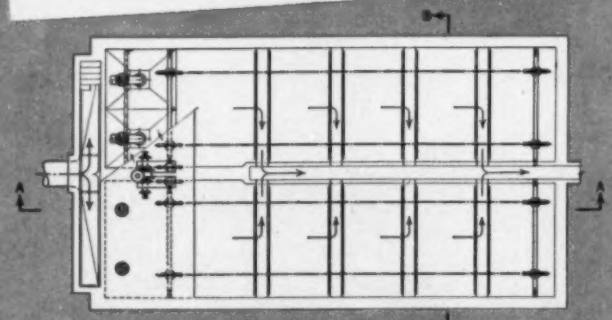
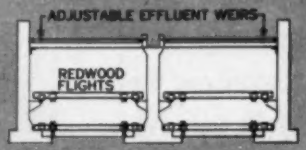
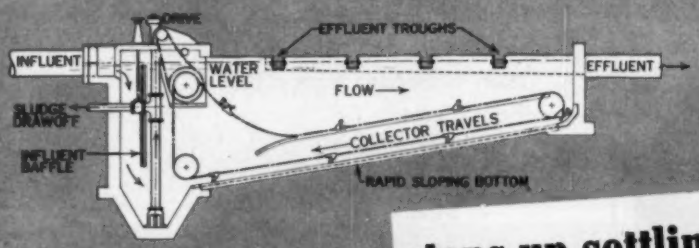
NEWARK (2)	218 Industrial Office Bldg.	DALLAS (1)	1223 Praetorian Building
CHICAGO (3)	1222 First National Bank Bldg.	SEATTLE	526 Lane Street
LOS ANGELES (48)	6399 Wilshire Blvd	SANTA CLARA, CAL	625 Alviso Road

VISIT OUR EXHIBIT—AMERICAN WATER WORKS ASS'N. CONVENTION, SEATTLE—BOOTHS 33 & 34—MAY 23-28

New UNIFLOW settling tank







Link-Belt's new UNIFLOW settling tank can be utilized for economical removal of solids from water, sewage or industrial liquids. Uniflow tanks are equipped with Link-Belt Straight-line Sludge Collectors which will remove sludge from the tank floor and scum from the surface.

steps up settling efficiencies . . cuts construction costs

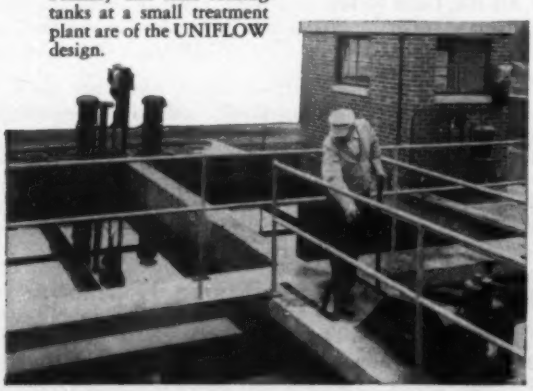
LINK-BELT development offers new economies for water, sewage and industrial liquids treatment

WITH its rapidly sloping bottom and multiple effluent weirs, Link-Belt's new UNIFLOW settling tank represents a big design advance. These, combined with the decreasing cross sectional area, provide *uniform velocity throughout the tank.*

Result: Better settling conditions . . . low overflow rate . . . uniform discharge from a large area of the tank surface. In fact, on one New England experimental installation, UNIFLOW gave practically the same efficiency in B.O.D. and suspended solids removal as a conventional tank with one-third more volume.

The new economies possible with UNIFLOW are typical of the development work constantly under way at Link-Belt. If you have a water, sewage or industrial waste problem, our engineers will work with your engineers, chemists and consultants. They'll help you get the finest in modern treatment equipment.

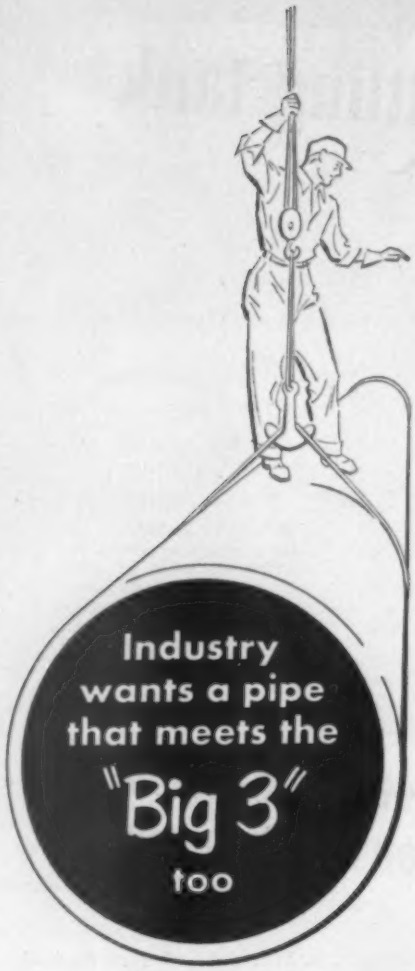
Primary and final settling tanks at a small treatment plant are of the UNIFLOW design.



LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.483

LINK BELT

SANITARY ENGINEERING EQUIPMENT



Price Pressure Pipe meets *every one* of the "Big 3" requirements for an ideal water supply line: *long life, great strength and sustained high carrying capacity.*

Many cities have learned this.

Typical are:

Louisville, Ky.
Cleveland, Ohio
Miami, Fla.
Rochester, N. Y.
Dayton, Ohio
Saginaw, Mich.

Now some of the nation's biggest industries are picking Price Pipe for their own water systems. One of the nation's famous soup companies just installed 7,000 feet of 20-inch Price Pipe at their Ohio plant. In Cincinnati, the Southwestern Ohio Water Company (operated by Mill Creek Industries) is using 19 miles of Price Pipe.

In Louisville, the pressure sewer system for the Ford Motor Company includes 16, 20, 24, 30, 36, 42 and 48 inch Price Pipe.

Study the advantages of Price Pipe for any type of water supply or pressure sewer line. Phone or write for all the facts today.

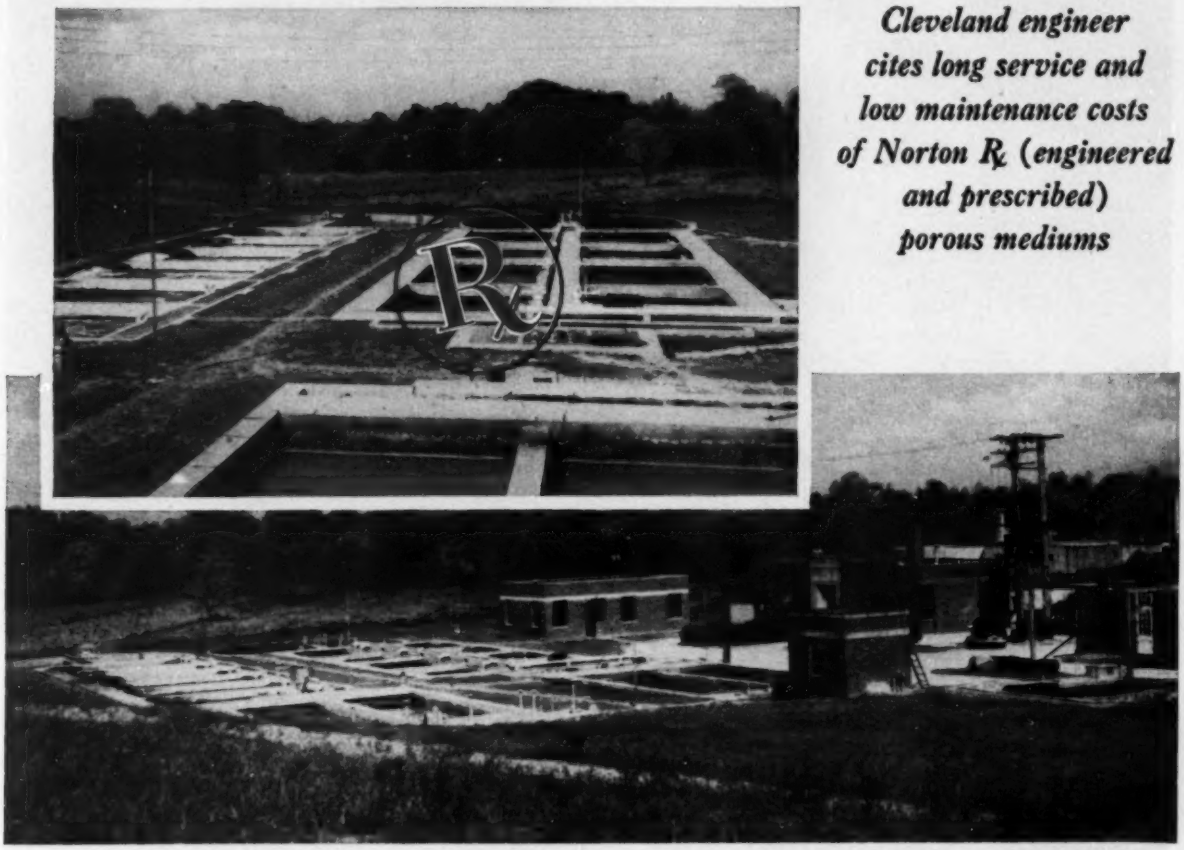
Price Brothers Company

1807 East Monument Ave. • Dayton 1, Ohio

Concrete Pressure Pipe for Water Supply Subaqueous, Pressure Sewer and Culvert Installations

"We think highly of Norton plates"

Cleveland engineer cites long service and low maintenance costs of Norton Rx (engineered and prescribed) porous mediums



Plates In This Berea, Ohio, Sewage Plant are from the famous Norton line of Rx porous mediums, engineered and prescribed for many important uses. Smaller photo shows close-up of tanks.

"We think highly of Norton plates. In fact, your plates at Berea, Ohio, installed in 1937 are still intact and were cleaned for the first time in 1951."

This message from Rollin F. MacDowell of Rollin MacDowell & Associates, Consulting Engineers of Cleveland, describes a specific installation where Norton Rx porous mediums insure top performance and keep maintenance costs down.

All Norton ALUNDUM* porous mediums are made with the patented *controlled structure* process that assures even distribution of pores — for uniform diffusion — in the size and open-pore ratio that best meets your needs. And Norton tubes have the seamless construction that provides unobstructed diffusion over their entire area and enables faster, more thorough cleaning.

Other Big Advantages

of Norton Rx porous mediums include exceptional resistance to breakage and chipping and their ability to stand up under cleaning with acid. They're made in a wide range of sizes . . . tubes and discs for aeration in activated sludge treatment . . . tubes for diatomite filters in swimming pools . . . plates for rapid sand filters in water filtration.

Get The Whole Story

Norton illustrated booklets bring you helpful charts, tables and important information on your own use of porous mediums. Ask your Norton Representative, or write direct to NORTON COMPANY, 223 New Bond St., Worcester 6, Mass.

NORTON

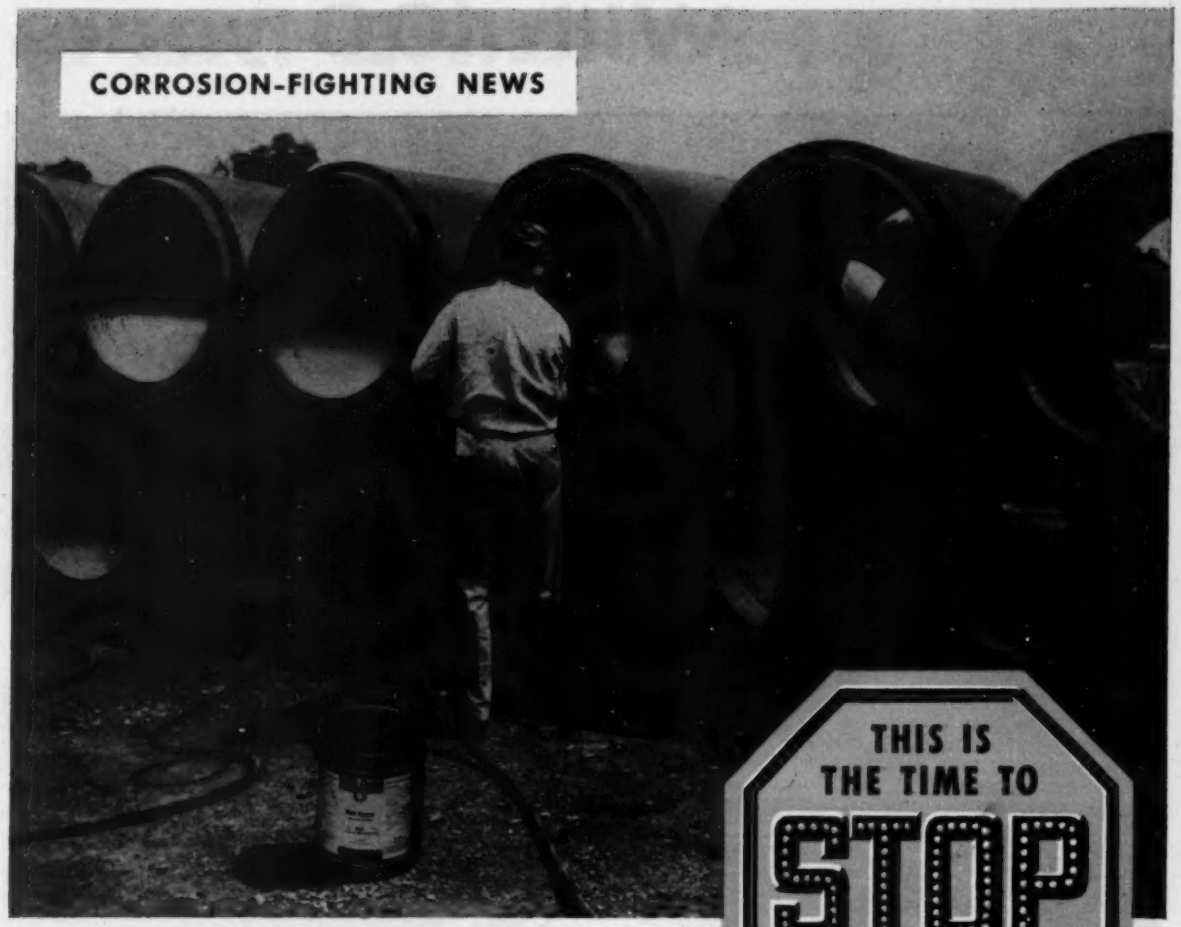
POROUS MEDIUMS

Engineered . . . Rx . . . Prescribed

Making better products . . . to make other products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

don't stick your neck out!
When you know cast iron pipe lasts over 100 years—
When you know cast iron pipe is inherently strongest, toughest, uniform in quality—
When you know cast iron pipe has a matchless history of low installation and low maintenance costs—
When you know cast iron pipe's long, trouble-free life saves millions of tax dollars—
When you know cast iron pipe is the standard conduit for carrying water underground—
When you know all these facts, then you know, too, it's unwise to experiment with substitutes. Experienced city officials look to cast iron pipe's proven record as their guarantee of a sound long-term investment. And, for over three-quarters of a century, they've learned to look to Clow for the finest cast iron pipe made. They have found consistent high quality coupled with excellent service and fast delivery. They've found centrifugally cast Clow Cast Iron Pipe offers the greatest economy, and it meets all currently approved specifications now in existence. Write today for complete information.
JAMES B. CLOW & SONS
201-211 E. Tilman Avenue • Chicago 80, Illinois
and these National Cast Iron Pipe Divisions
CAST IRON



There's only one sensible way to fight sewage corrosion: Stop it before it starts. Coating your pipe, tanks and equipment with *Pitt Chem* Tar Base Coatings before you put your plant into operation is like buying an insurance policy against corrosion problems for many years to come. Pitt Chem offers you three outstanding benefits:

1. **Longer-lasting protection.** Pitt Chem stands up to sewage corrosion 7 to 10 years longer than ordinary paints. Yet it costs no more per gallon.
2. **Economical application.** No special paint crew is required. Your own men can apply coating after a few simple instructions.
3. **Durable Bond to most materials.** Pitt Chem forms an excellent long-lasting bond with metal, masonry, cement and stone.

Add up these unique benefits and you'll agree: *No other material does such a complete job of protection at so little cost.* ● A *Pitt Chem* corrosion control booklet will gladly be sent to you on request.

WAD 4958

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
PITT CHEM 104—Potable Water Service
PITT CHEM 105 AQUATAR—A Water Dispersion
PITT CHEM 106 TARMASTIC—Sealing Compound
PITT CHEM 107 PACHKOTE—Specialty Coating
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With 100 years

Ewing Galloway

This is New York, as seen from East River, showing Empire State, Chrysler and United Nations buildings.

Bettmann Archive

Old print showing cast iron water mains being installed in New York about 100 years ago.

MODERNIZED cast iron

of EXPERIENCE... they must be right

NEW YORK installed cast iron water mains 100 years ago... and installs them today!

One hundred years ago, New York was a city of about 750,000 population, served by 237 miles of water mains. Today's eight million population requires 5500 miles of mains, of which 98% are cast iron. Some of these mains are still functioning after a century and more of service. From 90 M.G.D. a century ago, capacity has grown to 1500 M.G.D.

A customer who buys your product year after year—generation after generation—is a "jewel beyond price". Be you merchant or manufacturer, you might count such customers on the fingers of your two hands. Yet, the cast iron pressure pipe industry can count more than 60 of them—utilities that have been buying cast iron pipe for water or gas mains (or both) for 100 years.

Cast iron pipe has been a rugged, long-lived product from the earliest days. Today's *modernized* cast iron pipe, centrifugally cast, is even stronger, tougher, and more uniform in quality. And, where needed and specified, it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout the long life of the pipe.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

In good condition after 100 years of service, this cast iron distribution main is one of several still functioning in New York City.

pipe FOR MODERN WATER WORKS OPERATION

This Hersey Detector Meter with a bronze case Compound Meter on its by-pass will do a better job in measuring all rates of flow than any other combination of meters on the market.

Approved by the National Board of Fire Underwriters in 6" 8" 10" sizes

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK PORTLAND, ORE. PHILADELPHIA ATLANTA DALLAS
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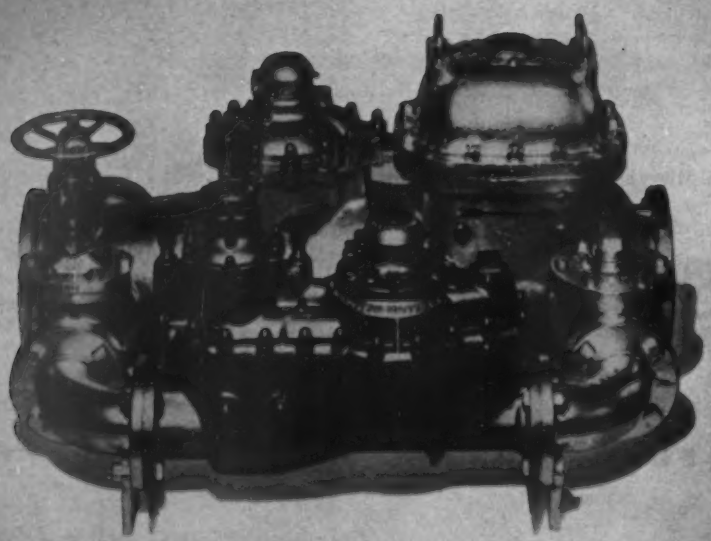

It's Not by Chance . . .

1,000,000-gal. Horton reservoir at Hot Springs, New Mexico.

. . . that Horton Reservoirs are thought of first!

This 1,000,000-gal. reservoir was built by CB&I for the city of Hot Springs, New Mexico. It's not by chance that Horton® steel reservoirs like this one are thought of first to provide storage facilities where natural elevations are available. This preferred position is the result of years of experience—proper facilities—and the desire to provide you with the best possible structure your money can buy.

If planning new improvements, write our nearest office for estimates or quotations on a Horton reservoir or standpipe to improve your water system. Also, ask for a copy of our informative booklet, *Horton Steel Reservoirs and Standpipes.*

HORTON

WELDED STEEL

STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

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Birmingham 1	1506 North Fiftieth St.	New York 6	5390—165 Broadway Bldg.
Boston 10	1048—281 Devonshire St.	Philadelphia 3	1644—1700 Walnut Street Bldg.
Chicago 4	2198 McCormick Bldg.	Pittsburgh 19	3260 Alcoa Bldg.
Cleveland 15	2282 Midland Bldg.	Salt Lake City 4	550 West 17th South St.
Detroit 26	1551 Lafayette Bldg.	San Francisco 4	1583—200 Bush St.
Havana	402 Abreu Bldg.	Seattle 1	1530 Henry Bldg.
Houston 2	2115 C. & I. Life Bldg.	Tulsa 3	1646 Hunt Bldg.

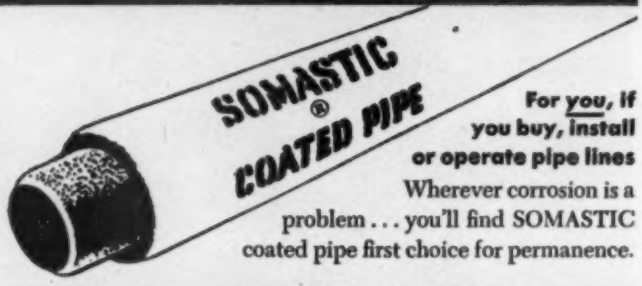
ONE gives you THREE!

source of supply — **pipe line processes**

TATE · CENTRILINE · SOMASTIC · TATE · CENTRILINE · SOMASTIC · TATE

1 SOMASTIC® PIPE COATING

Pipe Linings, Inc. manufactures and applies the world-famous and proven SOMASTIC Pipe Coating for exterior protection against corrosion in the 11 Western States and All Foreign Locations.



For you, if you buy, install or operate pipe lines

Wherever corrosion is a problem . . . you'll find SOMASTIC coated pipe first choice for permanence.

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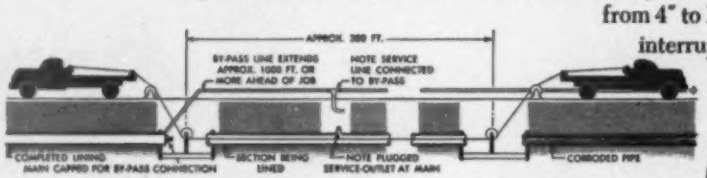
2

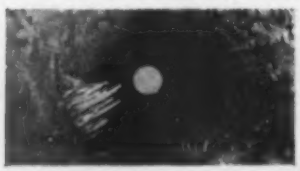
THE TATE PROCESS, applicable to water, oil and gas pipe lines, renews old iron and steel pipe "in place" as shown here in the schematic drawing. The Tate Process is used for pipe lines from 4" to 16" in diameter. Only momentary interruption to service is necessary while by-pass sections are installed.


APPROX. 300 FT.
BY-PASS LINE EXTENDS APPROX. 1000 FT. OR MORE AHEAD OF JOB
NOTE SERVICE LINE CONNECTED TO BY-PASS
COMPLETED LINING MAIN CAPPED FOR BY-PASS CONNECTION
SECTION BEING LINED
NOTE PLUGGED SERVICE-OUTLET AT MAIN
CORRODED PIPE

TATE · CENTRILINE · SOMASTIC · TATE · CENTRILIN

3

THE CENTRILINE PROCESS is used for lining 16" to 144" pipe lines "in place." Cost is much less than the cost of installing new pipe. Premixed cement-mortar is thrown by centrifugal force, at uniform high velocity, against the inside surface of the pipe, and then mechanically troweled to a smooth, even finish. Centrilining is applicable to fresh or salt water, oil, sewage, gas or industrial waste lines, sewers and drains.



You Get These Advantages From Cement Mortar Lining!

- New pipe performance
- Prevents leakage
- Restores full flow coefficients
- Reduces pumping and maintenance costs
- Protects against corrosion, contamination and discoloration at much less than the cost of installing new pipe!

Complete mobile equipment and expert crews are available to bring new efficiency to your old pipe. A Pipe Linings, Inc. hydraulic engineer will be glad to discuss your problem. No obligation!

PIPE LININGS, INC.

It's a big jump

to SEATTLE

and the A.W.W.A. Convention

May 23 to 28

We'll hit the silk and get there in time to extend you a warm welcome. Be sure to visit the R. D. Wood Company's booth. There will be a display of R. D. Wood products, including America's best-known hydrant, the Mathews.

MATHEWS HYDRANTS

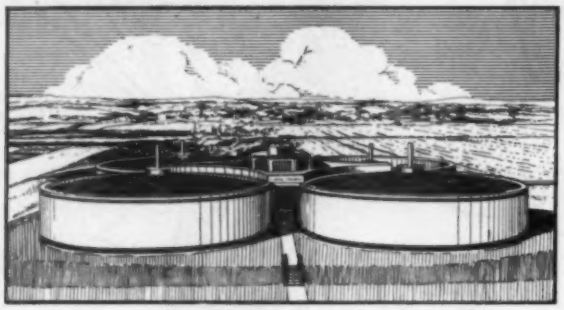
Made by R. D. Wood Company

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

New developments in "controlled digestion"

A STATEMENT OF POLICY



In the development of controls for the separate sludge digestion process, the Pacific Flush Tank Company has been a leading contributor. The P.F.T. Floating Cover was developed to provide means for positive submergence of the scum in the seeding liquor and allow safe gas utilization. P.F.T.'s development of external heating of recirculated digester contents and raw sludge assures the maintenance of constant optimum digester temperatures. And more recently the development of the P.F.T.-Pearth Gas Recirculation System provides a positive means for the rapid dispersion and elimination of scum accumulations.

Our Policy is Clear—With our many contributions to the basic knowledge of the sludge digestion process, it has always been our policy to point out the advantages of closely controlling all factors affecting digestion. With effective controls, operational difficulties are eliminated and successful digestion results—the production of an inoffensive sludge of uniform concentration suitable for ultimate disposal.

We will continue to advocate the use of established design criteria for digestion capacity as formulated by consulting engineers and State Boards of Health. We feel that these criteria are developed to take into consideration practical plant operating procedures and future requirements. These criteria cannot be based solely upon results of pilot plant studies which require careful control by staffs of highly skilled technicians.

The introduction of the P.F.T.-Pearth Gas Recirculating System provides an economical means of dispersing scum accumulations, making the total digester volume available for effective digestion. There is no *mysterious* action in the operation of any gas recirculating system. It is merely a *mechanical* action which aids the normal biological activity by breaking up the scum so that it can be digested.

To those interested in sewage and waste treatment, Pacific Flush Tank Company will continue to offer straight-forward information about all of its equipment and new developments.

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
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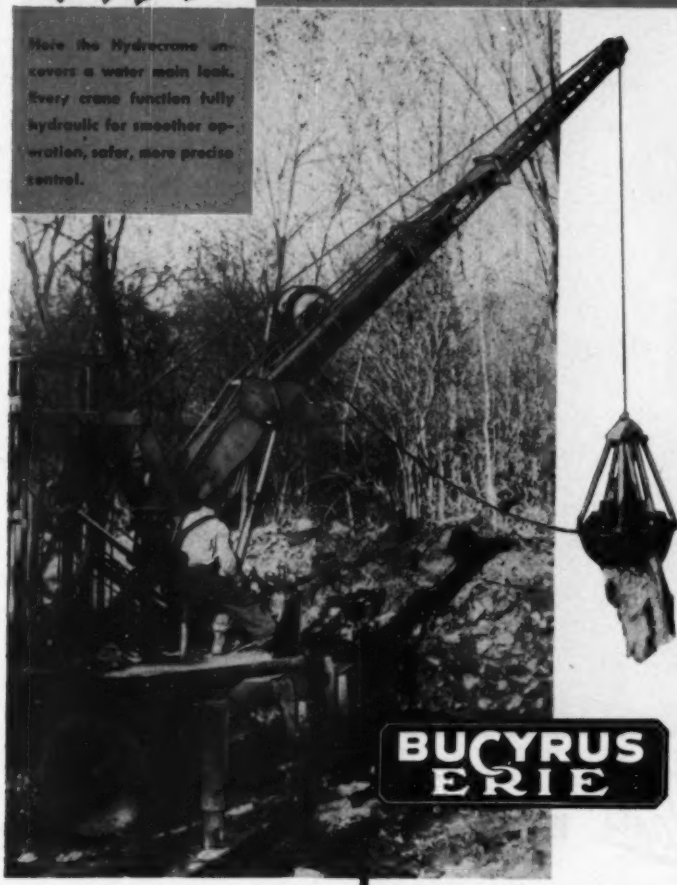
NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

WORKHORSE on Routine Jobs

RACEHORSE on Emergency Calls



Here the Hydrocrane uncovers a water main leak. Every crane function fully hydraulic for smoother operation, safer, more precise control.

The versatile Bucyrus-Erie Hydrocrane is a proved money saver on countless sewer and water department jobs, day-in, day-out. It does them quickly, smoothly, economically.

AND IN AN EMERGENCY IT'S A REAL "LIFESAVER". LOOK:

On hurry-up calls, operator can wheel the compact Hydrocrane through traffic almost as easily as he would an automobile. Telescoping boom fits snugly over cab instead of bobbing out behind. On open highway he can step 'er up to 50 mph — save precious minutes that often save close-budget dollars.

As soon as it reaches the job site, the Hydrocrane whips into action. Outriggers extend hydraulically in seconds—providing a firm, solid working base. No time out for cribbing or blocking. Short tail swing and maneuverability make it the choice for close quarter work.

Busy As A Bee—

This Free Book Tells Why!

QUICK CONVERTIBILITY ANOTHER ADVANTAGE

If the job calls for a dragshovel the Hydrocrane can be converted to Hydrohoe front end by one man in "jig time." Owners report making this conversion in *less than one man-hour.* Even when time is short such speedy convertibility makes it practical to change attachments.

22H53

Pictures tell the story of 82 Hydrocrane and Hydrohoe applications in this handsome booklet. Write for your copy now.

Join the growing list of enthusiastic Hydrocrane users. See your Bucyrus-Erie Hydrocrane distributor for a demonstration on your job.

BUCYRUS-ERIE COMPANY

SOUTH MILWAUKEE, WISCONSIN

SOME THINGS *Can't* BE MEASURED

A man can measure the accuracy of a Trident meter. He can check for himself its workmanship, have its materials tested, test the ease of assembly and disassembly.

But some things can't be measured. For instance, the kind of friendly informative service that a Neptune salesman gives his customers . . . service that has brought many of them official awards from the water works field.

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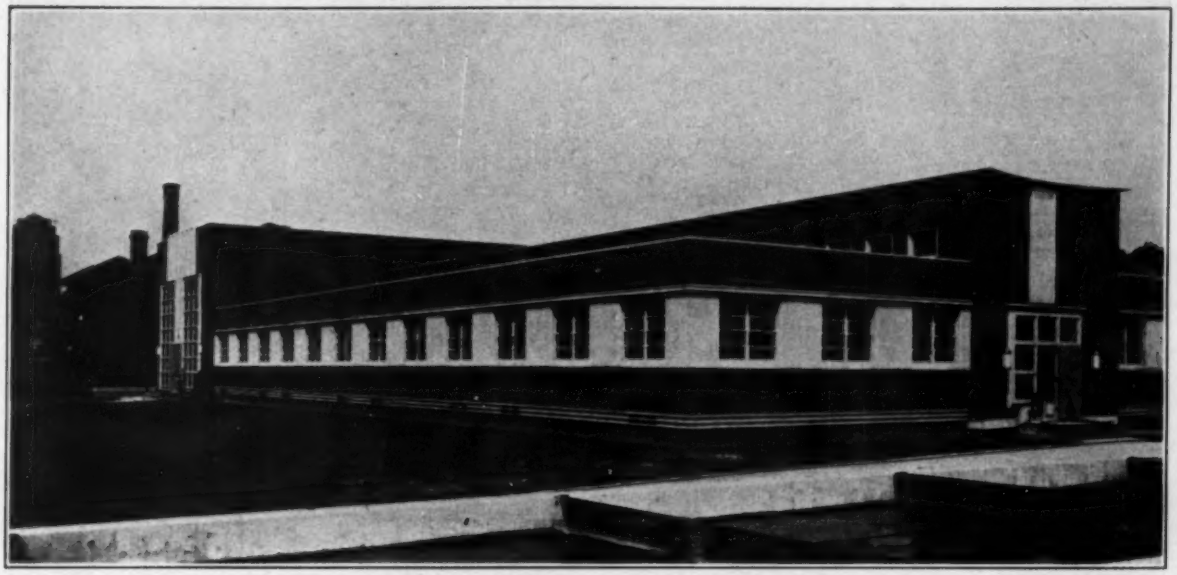
WATER & SEWAGE WORKS

VOL. 101, NO. 4 • A Scranton Gillette Publication • APRIL 1954



ALLENTOWN'S new 20 mgd filtration plant.

Allentown Stays Ahead of Increasing Water Demands

A story of efficient planning that has kept water supply ahead of the city's rapid growth

by **HARRY J. KRUM**, *Supt., Bureau of Water, Allentown, Pa.*

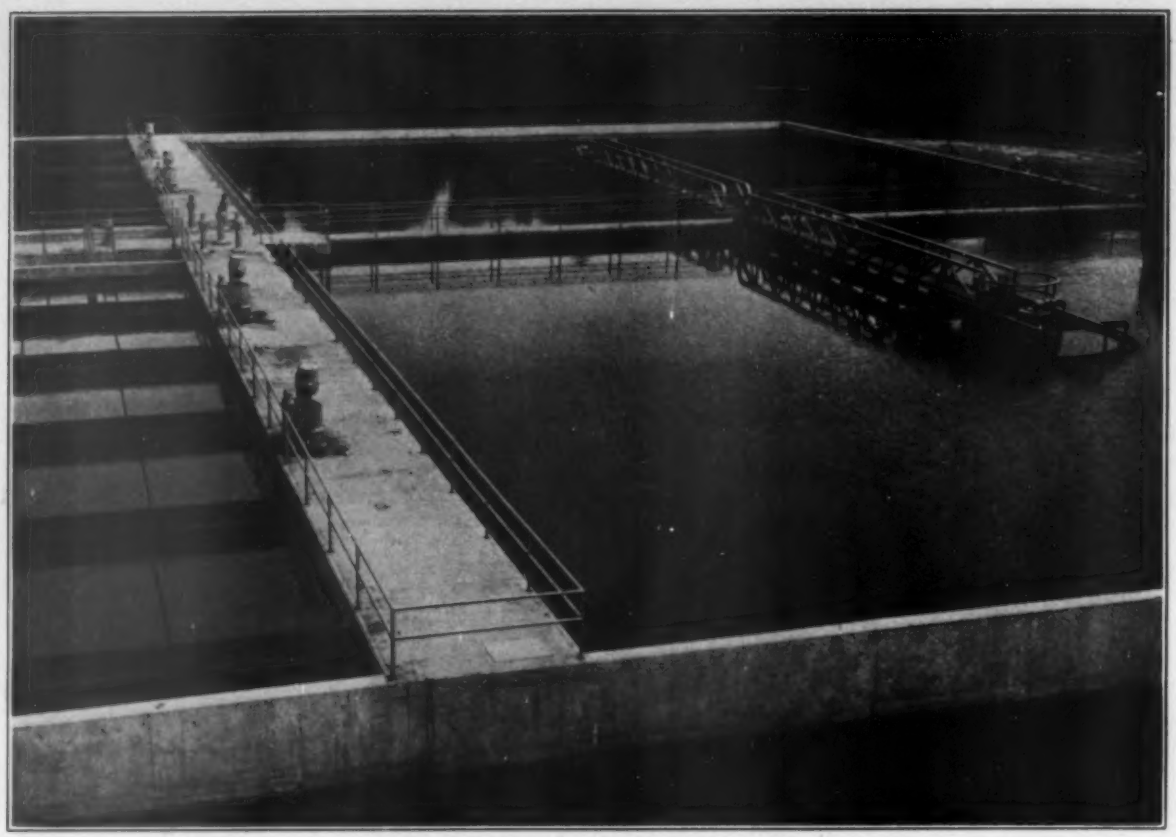
THE recently completed 20 mgd filtration plant and pumping station is the latest step taken by Allentown, Pa., to keep its water supply well ahead of the needs of this growing, progressive community. Supplementing the existing 10 mgd filtration plant, the new 20 mgd plant has been built with the idea of being prepared to meet any increase in water demands for the next twenty-five years. Taking into account recent history in the growth of water demand per capita the new plant may reach its capacity in fewer than the quarter-century.

Allentown's water works, dating back to 1820, was one of the earliest water systems in the country and has an unbroken (perhaps enviable) record of having always managed to expand its water supply in time to meet the greater needs of subsequent population growth and increasing industrial demands.

The need for our recent expansion became apparent during World War II, when Allentown's industries grew to new proportions almost overnight and pushed water consumption to a high rate. We began our planning, then, for enlarging the city's water facilities. Drawings and specifications were prepared by Morris Knowles, Inc., consulting-engineers of Pittsburgh, in 1948 for the 20 mgd filtration plant and a high lift pumping station. In August, 1953, we opened the doors of our new facility for dedication ceremonies and public inspection. L. D. Matter, Assistant Chief Engineer of the Pennsylvania State Health Department, said then:

"In our modern, rapid-moving urban life none of the necessary public services is more vital to a community's welfare than a satisfactory public water supply; satisfactory as to quality as well as quantity. Today, a supply must first of all be safe for domestic use—that is paramount—but it also must be pleasing and acceptable."

"It is unfortunate, but true, that the average citizen fails to appreciate the important part the public water supply plays in his every day life—until there is an interruption in the service. He expects that, when he turns on a hydrant, something will come out of that hydrant, and if nothing happens, he feels that he is being discriminated against and he immediately picks up the telephone and calls the Water Department to find out why he is not get-



NEW flocculators (left) and Dorrco clarifiers

ting the service for which he pays good money."

Fortunately, this situation does not exist in Allentown. The sources of water for the new plant are Little Lehigh River (30 mgd), Schantz Spring (9 mgd) and two deep wells (3 mgd). Available, but not used, is 2.5 mgd from the city's Crystal Springs. Water from Schantz Spring does not need to be filtered, only chlorinated.

Since the present water consumption is about 20 mgd, Allentown presently enjoys a reserve of over 22 mgd. This is a comfortable reserve for Allentown's present population of 107,000 and for the number of industrial plants operating here today. But knowing of Allentown's resources and potential for rapid growth, we are constantly aware of future needs. Actually, we are merely following the pattern of our city forefathers' thinking. It was their farsighted planning that has made it possible for succeeding generations in Allentown to enjoy a bountiful supply of good water.

History of Progress (1820-1953)

The first water works of Allentown was built along the Little Lehigh Creek more than a century and a quarter ago by a private firm known as the Northampton Water Co. Water was pumped through pipes to a stone reservoir, called "the cistern," which was located within the city's limits. In 1852, an additional cistern was built to hold 65,000 gallons. The population then numbered 3800, but plans had already been laid to build a water system to accommodate a much larger population.

The City of Allentown purchased the water system from the Northampton Water Co. in 1869 and named it the Municipal Water Works. The population had grown to 12,000 and water consumption averaged 600,000 gpd. Plans were again being made to expand the water system to meet the future needs of the still growing city. These plans were put into effect in 1887 and the city purchased a hotel for use as a pumping station. Two pumps and a standpipe were installed in the new "Pumping Station." In 1897 an additional standpipe was installed and a new 30-inch main was laid to secure increased water pressure to various parts of the growing city.

Allentown was fortunate in having two springs within city limits near the Little Lehigh River. Water was taken from these springs and fed directly into the city mains. But in 1912, it became necessary to chlorinate the water. This, in turn, led to setting up Allentown's first Water Works Laboratory. Chlorination was handled by a mechanical chlorinator that fed chlorine gas directly into the water supply without benefit of a minor water stream to dissolve the gas en route to the major flow.

It became apparent in this period that the day was rapidly approaching when Allentown would need more water than could be supplied by the two natural springs. Plans were drawn for a major increase of water supply. These plans came to life in 1929, when a new filter plant with a capacity of 10 mgd, and an enlarged laboratory, were built. Then, in 1937 another major construction plan was carried out with the building of two service reservoirs having a total capacity of 40 mgd. The system was further strengthened the following year when booster pumping stations were added to the expanded system.

Recent Major Construction

During World War II, Allentown's old industries expanded and new ones sprouted rapidly. It was evident that although existing water supply was

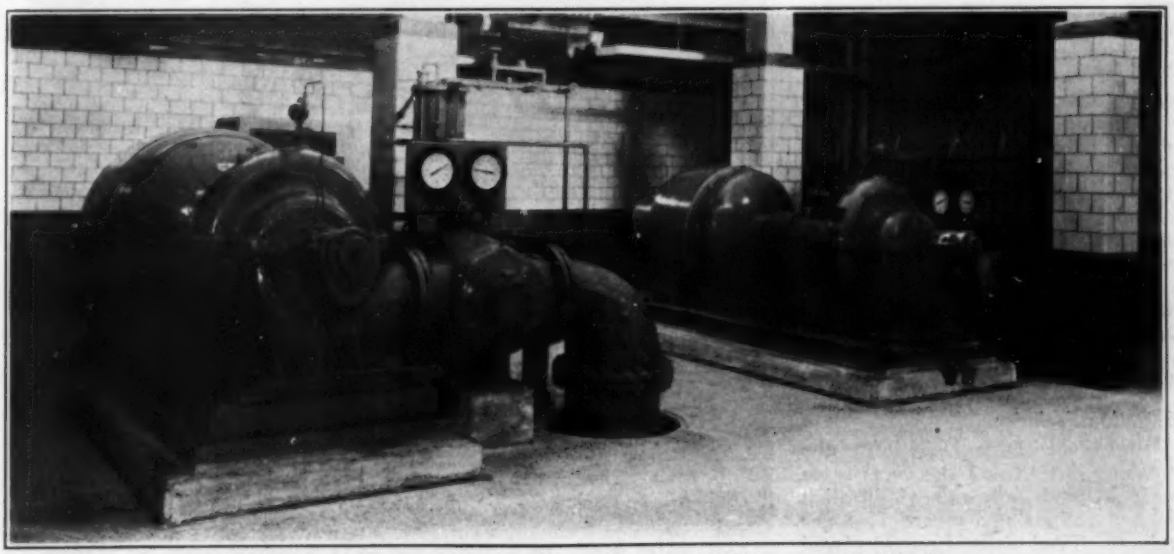
INTERIOR of new eight-unit 20 mgd filtration plant

sufficient to meet present needs, it would not suffice for future needs. Plans were made to enlarge the filtration plant to increase the capacity of the water system by 20 mgd.

Since the city wanted to use as much of the old facilities as possible in conjunction with the new, plans and specifications for the new facility had to combine the existing three low lift pumps and equipment of the 10 mgd filter plant (built in 1929) with installation of new equipment. Despite careful planning to keep enough equipment in operation during the change-over, we suffered a short supply and lack of reserve for three weeks.

Raw Water Pumping

The filtration process starts in the new screen house where the rotating mesh screen removes fish and debris. Chlorine is added to the raw water at the inlet to the four 10 mgd horizontal De Laval centrifugal pumps, two of which were used for 20 years



HIGH SERVICE pumps. De Laval 9 mgd and 11 mgd deliver to distribution system at 88% efficiency

ELECTRICAL control panels and switch-gear by Westinghouse

in the old pumping station and are still considered satisfactory for many more years of service. The pumps must give efficient operation over a wide range of low head pumping conditions. By operating a combination of pumps, the station can obtain operating conditions to meet any demands. These modern pumps and the others throughout the station, with their versatility and power, mark the growth of pumping equipment when contrasted with the city's early installations.

Back in 1820, Allentown's water system (one of the first in America) used water power through turbine-driven pumps to get spring water through a 12-inch pipe to the stone reservoirs. In 1887, the pumping station, housed in a converted hotel, used two pumps and a standpipe. Ten years later, another standpipe was added and a 30-inch main laid. About 40 years ago, spring water was sent into the mains by water-wheel powered pumps.

After the water has been chlorinated in the screen house, De Laval centrifugal pumps deliver it to the treatment facilities where alum is added by mechanical proportions and flash-mixed. The chemically-treated water then goes to the Dorr mechanical flocculating equipment. Settling of four hours, an increase of two over the old plant, improves the quality of the water sent to the filter beds.

Filtration Facilities

Eight new filter beds bring the total to sixteen and the capacity to over 30 mgd. The rate of filtration is two gallons per square foot per minute. Tiled walls, Leopold glazed tile filter bottoms, concrete troughs and submerged lighting are features of the new filters. Filter equipment also includes Palmer Surface Agitators and sand expansion indicators. Gravel depth and sizes in the new beds are 12 inches and ⅛ to 2 inches respectively. The sand depth is 30 inches.

The Laboratory

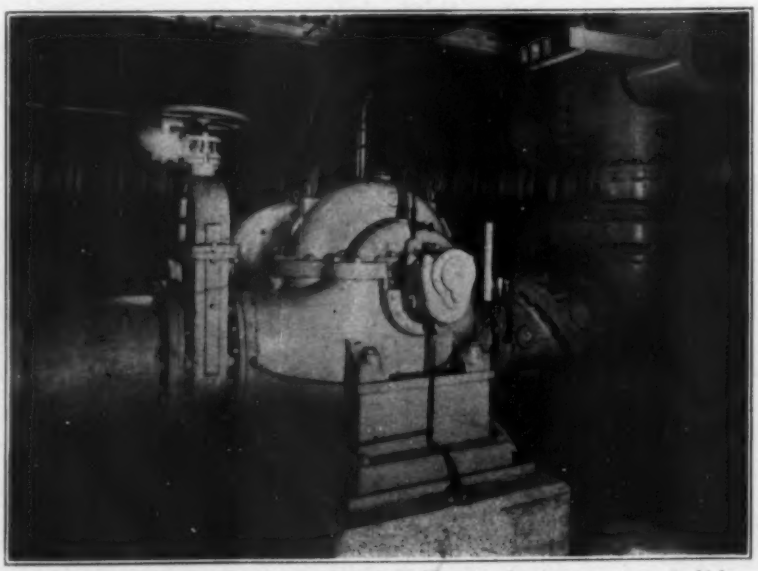
Chlorination was started in 1912 when the spring water was found to be slightly polluted. The first laboratory for Allentown's water works was established in 1914 to test the water and control chemical feeding. The feeding device was three 50-gallon barrels of chlorinated lime. In 1915 a mechanical gas feed chlorinator was installed.

In the plant laboratory frequent checks are made of the water at every step of its passage from screen house to distribution system. Water samples from intake screen, flocculating basin, settling basin, filter beds, the springs and other areas are piped into the laboratory. We just turn the correct faucet for the desired sample.

High Service Pumping

Leaving the filter beds, the water, metered and tested, goes to the clear well. A silver dollar dated 1886 (which, incidentally, is also my birth year) has been placed on the well's floor to show visitors who look through the well window how clear the water is.

Three 15 mgd electrically driven



RAW WATER pumps. One of four 10 mgd De Laval low-head pumps, two of which have seen 20 years of service

De Laval high-lift pumps with 278 ft. total discharge head take the water from the clear well through intake pipes placed on the floor of the well. These pumps (see cover picture) are primed by an elaborate timing and electronic system consisting of vacuum pumps and an emergency water ejector. In the priming cylinder are three electrodes which measure the level of the water and prime the pumps accordingly.

A control panel with signal lights to indicate when pumps are ready to start has switches to start each pumping unit after it has been primed. Automatic valves open or close in each high head pump depending on whether the unit is being added to or taken out of the distribution system.

In addition to these three 15 mgd high lift pumps, there are two De Laval pumps (9 mgd and 11 mgd) which draw water from Schantz Spring for delivery into the distribution system direct. With this combination, varied capacities can be obtained depending on the demand. At full speed the 9 mgd unit is designed for 6300 gpm at 225 ft. tdh with an efficiency of 88 per cent, and the 11 mgd for 7700 gpm at 242 ft. tdh with an efficiency of 88 per cent.

The high head pumps send the water on to the distribution system and to two covered reservoirs whose total capacity is 40 million gallons. The reservoirs (built in 1937) float on the distribution system which consists of 216 miles of distribution lines.

Highest pumping rate to date has been 24.5 mgd. High and low pumps alternate in use every week to give each piece of equipment the same amount of running time. The level of water in the reservoirs tells us the amount of high service pumping equipment we need on the line. This program can be followed since the high head pumps are designed for the 42 mgd maximum output of the plant.

It is now believed that Allentown's present water supply system will meet the needs of any growth in population and industry that are expected to take place in the next twenty-five years.

Convenient and Effective Method for the Disinfection of New Mains

by **J. R. ROSSUM**, *Sanitary Engr., California Water Service Co., San Jose, California*

THE American Water Works Association published a tentative procedure for disinfecting water mains (A.W.W.A. C601-53T) in August of 1953. The procedures outlined are capable of producing satisfactory results, but many utilities do not follow these procedures rigorously.

For example, Tenny* reports that a poll of seventeen water works in Iowa disclosed that over half of them chlorinated mains by placing dry hypochlorite powder in each joint of pipe as laid. This method has been severely criticized, but low cost and convenience have outweighed whatever lack of reliability the method many possess.

The principal objections to this practice are: (a) that the main cannot be flushed prior to sterilization, and (b) that it is impossible to prevent washing most of the disinfectant to the far end. It is not difficult to eliminate the need for preparatory flushing of a new main by exercising reasonable care in the handling and laying of the pipe. The availability of high-test calcium hypochlorite ("HTH") in tablet form suggested an attempt to devise a means of holding the disinfectant tablets in place while the main is filled.

Preliminary investigation showed that if "H.T.H." tablets are fastened to the interior top of a large glass tube with an adhesive, they will dissolve over a period of several hours, and that the density currents generated by the solution of the chemical will carry the hypochlorite solution a distance of several pipe lengths. Field experiments revealed that the various adhesives used in the laboratory were unsuitable in practice. After many trials, hot tar was selected as being the most satisfactory of the materials used. A gasket cement known as "Permatex No. 2" has also been used successfully when hot tar is not available on the job.

*Tenny, M. K., "Quaternary Ammonia Compounds for Main Disinfection" — Jour. A.W.W.A.; 43, 82—Jan. 1951.

Procedure

The procedure is as follows:

Fasten the required number of tablets (see Table I) to the inside top of every length of pipe as laid. Hot tar is applied to one side of each tablet, using a piece of wood about the size of a popsicle stick. So that water can come in contact with as much of the tablet as possible, care should be taken to see that the adhesive does not cover the edges or exposed face of the tablet. Any trace of dust should be wiped from the area of the pipe where the tablets are to be fastened.

When Dresser or similar couplings are used, half a tablet of "HTH" is crushed and placed in the annular space between the coupling and the pipe.

The main or extension is filled slowly with water and allowed to stand for 24 hours. It is then flushed and bacteriological samples taken in the usual manner.

The method is recommended for short extensions and for small diameter pipe of any kind. The scheme cannot be used where trench water enters the pipe.

Although the tablets vary somewhat in size, Table I will give a minimum chlorine dose of 30 ppm.

This procedure has been used for almost two years by the California Water Service Co. and several hundred jobs have been disinfected. Bacteriological tests have shown the procedure to be at least as satisfactory as the tentative procedure adopted by the A.W.W.A. which involves greater dosages of available chlorine.

TABLE I

Length of Section	Diameter of Pipe Line or Main					
	2"	4"	6"	8"	10"	12"
13'	1	1	1	2	3	3
18'	1	1	2	2	3	5
20'	1	1	2	3	4	5
30'	1	1	2	4	5	7
40'	1	2	3	5	7	10

Maine Water Utilities Ass'n's Record Meeting

Portland Water District Host for 28th Year

SPEAKERS table at luncheon
Honored guests—Portland's Mayor and City Attorney

MAINE'S Water Utilities Assn. held its 28th Annual Midwinter Meeting in Portland on Feb. 9 and 10 to record a new high in attendance. More impressive than the 214 who registered was the aggregate of 2789 years of service in the water works field which was represented.

For the 28th year the Portland Water District was host to the M.W.U.A., serving a delectable dinner featuring P.W.D. famed clam chowder prior to the evening program which opens the meeting. The Douglas Street Service Building of the District is ideally suitable for the meeting and the manufacturer's exhibits set up in the spacious Garage Building. Also the meals are served within the same building by the wives and employees of the District.

Burgi on PWD's Operations

As is customery, the first evening program following the complimentary dinner is devoted to Portland Water District's activities and developments of the year.

Herman Burgi Jr., Treasurer and General Manager of the District presented an illustrated review of 1953 activities of the District and accomplishments of the year.

In the business end Mr. Burgi said that costs had caught up with the District which had not increased rates since 1907. Consequently a rate increase had been granted by the Maine Public Utilities Commission, based on careful studies of actual costs of operation. Because of the seventeen political sub-divisions served by the District, actually 23 sets of rates existed. Now three sets of rates is doing the job—(1) Flat Rates; (2) Cities' Meter Rates; (3) Town's Meter Rates. In addition there is a Season Rate for summer cottages, of which there are many.

The new Flat Rates are on a fixture basis with the first faucet step increased from $5.00 to $8.00 per year.

The President
Leander G. Smith, Sup't.
Kennebunk Water Distr.
Kennebunk, Me.

No. 1 Host
Herman Burgi, Jr., Genl. Mgr.,
Portland Water Distr.
Portland, Me.

The new Cities Meter Rate is a step rate with minimum charge based on meter size, and water use allowance. The domestic rate minimum of $3.00 per quarter, with 1,500 cu. ft. of water covered by this minimum, was designed to obtain 20 cents per 100 cu. ft. as the first step.

The new Town Meter Rate is also a step rate with minimum charge of $4.50 per quarter carries a water use allowance of 1,200 cu. ft.

To eliminate the excessive office work in connection with allowable discounts for prompt payment the new rates do not permit discounts in any category. The office work has been precipitately decreased along with argument and bickering.

The success of the rate change venture led to a second major change to cycle meter reading and billing. This change had likewise improved the workings of the business office.

Repairs to Lake Sebago Intake Tunnel

Mr. Burgi described the method of placing a liner in the leaking 60" intake tunnel from Sebago Lake through a rock ledge to the transmission mains to Portland. The project involved 700 ft. of liner. Selected for the liner was 16 ft. lengths of Lock Joint pre-stressed pipes of 48" inside and 56" outside diameter. The trick was the method of inserting these conduit sections into the 60" diameter rough walled tunnel for the 700 ft. length. Specially designed 3 ft. long steel sled runners were developed and strapped to each end of the 16 ft. sections weighing 6 tons each. The sections were pulled into the tunnel with steel cable on a No. 80 Northwest Crane. By telephone, directions were transmitted from a man riding the liner to the crane operator. The liners were eventually grouted in.

New Submarine Main

Mr. Burgi, described the spectacular operation of laying an 8" main from mainland across Casco Bay to the islands served. The new line of robust Molox (cement lined) Cast Iron Pipe was installed for more than a mile between two islands. A product of Am. Cast Iron Pipe Co., the rugged Molox pipe with its heavy ball and socket joints was developed for submarine crossings some years ago. Joint bolts are of special bronze to withstand salt water corrosion. However, all joints were grease coated and burlap wrapped as a further protection against bottom mud corrosion, since

EQUIPMENT EXHIBITS in P.W.D.'s spacious garage.
Center picture—Pres. Smith, Editor Anthony and John Stuart, Mgr. of Mfgr's. Assn. go into a huddle.

LUNCHEON and technical session following.
Speakers at the podium—Col. H. A. Mapes, State Director of Civilian Defense and Chas. Knoner, Engr., Pitometer Associates.

the line was laid in trench and covered as protection against freezing. Fresh water in submarine lines under salt water will freeze.

In laying the Molox pipe, three 16 ft. sections were jointed together on the laying scow and thereafter held in position by a strong back while being bolted to the string of pipe already partly submerged. As a guide for the descending pipe string, a 57 ft. long steel trough was employed, the end of the trough dragging on trench bottom. Joints were tightened with torque wrenches and a diver inspected pipe on the bottom after each three sections went down. Joints were tested for tightness with 70 lbs. air pressure. In the trench the pipes are not on a straight line but are zig-zagged to prevent possible strain from expansion and contraction of the more than a mile long line.

Mr. Burgi pointed out that existing badly leaking steel submarine lines are being replaced with the long-life Molox Ball and Spigot cement lined pipe as rapidly as permissible.

Loss of Carrying Capacity of Water Mains

On the day following "The Cause and Effects of Decreasing Carrying Capacity of Water Mains" was discussed by Charles J. Knoner Distr. Engr. for Pitometer Associates of New York City.

Mr. Knoner listed as causes of loss in carrying capacity the following: Tuberculation; incrustation; iron deposition; biological slime growths; partially closed valves. These were the more common reasons. He related the Pitometer Survey methods for location of restrictions, and partially closed valves by loss of head tests.

As corrective measures he said that main clearing without applying a protective coating, such as cement lining of mains in place, had been of temporary value only. Cleaned mains rapidly lose capacity due to re-tuberculation. As a protective measure water treatment to produce protective films of calcium carbonate had not been wholly effective and was unduly expensive. The importance of water main deterioration under modern practices of water treatment had received the attention of the Am. Water Works Assn. which is giving special attention to a study of the situation looking toward an effective solution.

LINN H. ENSLOW, editor of this magazine, asked to discuss the matter of corrosion control, said that he had come to think that water treatment for corrosion control had not been overly successful and thought that we would still have to depend upon materials and protective coatings as the true solution to the corrosion problem. He based his conclusions on practability and overall costs.

Getting down to protective films and coatings he felt that it would be difficult to beat cement linings for steel or iron pipes when considering all angles. His thinking was based on the history of cement lined wrought iron and steel pipe for service lines in New England. After many years of service these cement lined pipes had not failed from internal corrosion but only from soil-attack from the outside. Even where most of the cement had seemingly been dissolved from the lining the bonded sand remaining had surprisingly been sufficient protection against internal corrosion and rust-chokage or tuberculation. Apparently the shell of bonded sand had in some manner kept the oxygen away from the metal walls of the pipe and that had been sufficient to check the corrosion phenomena. For service lines and interior piping copper and red-brass had come into general use, but for the larger pipes cement lining possessed the greatest practical appeal.

Secy.-Treas.
Earle A. Tarr, Supt.
Winthrop Water Distr.
Winthrop, Me.

Vice Pres.
Francis L. Hatch, Sup't.
Kittery Water Distr.,
Kittery, Me.

Past. Pres.
Allan F. McAlory, Sup't.
Camden - Rockland Water Co.,
Rockland, Me.

Editor
Sidney S. Anthony, Supt.
Augusta Water Distr.
Augusta, Me.

Civil Defense Activities

Colonel H. A. Mapes, State Director of Civilian Defense, Augusta,

POPULAR were the equipment exhibits, as these pictures attest.

Me., highlighted progress and plans in the civilian defense program only recently launched in Maine in which water supply constituted an important element. He cited the initial steps of the U.S. Public Health Service in a survey endorsed by the A.W.W.A. to determine the adequacy or inadequacy of water supply facilities and planning in the civilian defense program.

SIDNEY S. ANTHONY (Augusta) as chairman of the M.W.U.A. Committee on Civilian Defense and Mutual Aid stated that the association is ready to give full cooperation to the program of the State Civilian Defense Agency. He referred to the valuable and widely used brochure published during World War II by the Association "Defense and Emergency Procedure" in water supply operations. The committee maintains a record of stock and supplies available to water works in case of an emergency. (Ed. Note: As far as we are aware the water works group in Maine had a working mutual aid plan long before World War II. On several occasions it had proved its worth in emergency situations.)

A Group Insurance Plan

Allan F. McAlary (Rockland) as chairman of the Association's Committee on Group Insurance rendered a report which discussed the group insurance plan which could be adopted for the Association provided at least one half of the members entered into this method of securing the most economical protection against losses due to sickness or accident. Upon recommendation that the plan be adopted by the Association, a vote taken showed a decided interest in the plan and that Mr. McAlary and the committee continue to develop the matter.

Central N. Y. Operators Form New Association

The Central New York Water Works Operators Association has recently been organized with more than 100 charter members. Gordon Rahm, superintendent at Ilion, N. Y., was named president and Lawrence J. Griswold, chief engineer of the Utica Board of Water Supply was chosen secretary-treasurer.

Robert Austin, associate hydraulic engineer of the Public Service Commission in Albany was the speaker at the organization meeting in Utica in February. Special guests at the meeting included Frank A. Emma, chairman of the Utica Board of Water Supply, and all Utica Commissioners.

Members of the governing committee are Robert Wade, water supt. for Herkimer; John C. Brayton, genl. mgr., Utica Water Board; A. J. Petrie, sup't. of water for Mohawk; and G. W. "Bud" Moore, district mgr. for Neptune Meter Co.

Death of Walter J. Leach

Walter J. Leach, a partner in the consulting engineering firm of Havens and Emerson, New York and Cleveland, died on March 5th at his home in West Orange, N.J. He had been associated with the firm and its predecessors since 1923, and a partner since 1951.

Mr. Leach served in the Army Engineers Construction Corps during World War I, and from 1941 to 1943 with the War Production Board in Washington, D.C., as Deputy Director of the Water Division. He was a licensed professional engineer in Ohio, New York, New Jersey, and Tennessee, and a member of many technical and professional societies.

Francis Friel Elected Vice-Pres. Am. Inst. Cons. Engrs.

Francis J. (Frank) Friel, president of Albright & Friel, Engrs., Philadelphia, has recently been elected vice-president of the Am. Institute of Consulting Engineers.

Mr. Friel has held numerous offices and committee chairmanships in technical associations. In the field of sewage and industrial waste treatment he is best known as a past-president of the Federation of Sewage Works Assns. He holds the honorary degree of Doctor of Engineering conferred in 1949 by Drexel Institute. He served two terms as president of the Philadelphia Section of A.S.C.E. and also a four year term on the National Board of A.S.C.E. In 1948 he was sent as U.S. Delegate to the meeting of the International Comm. on Large Dams at Stockholm, Sweden. In 1951 he was appointed by the U.S. State Dept. to represent the U.S. at the World Power Congress, the Industrial Congress on Large Dams and the International Hydraulic Congress.

Important Ruling On Water Service to Suburbs

The Public Service Commission of Wisconsin has recently established a precedent in its published opinion that a municipality cannot be required to provide water service in areas beyond the city's corporate limits.

In examining the case of Madison, Wis., wherein citizens living beyond the existing water mains were pressing for extension of water service, The Public Service Commission ruled in favor of the City of Madison. The official decision states that "The record does not disclose any facts from which the Commission can find that the City of Madison as a public water utility, has assumed or acquired any obligations to serve these outlying areas." The areas in question contain between 75 and 100 business places or residences.

To many, this precedent in the matter of extension of water service into non-profitable areas will prove reassuring.

Corrections Required in Plating Wastes Section of ACS Monograph

Professor M. Gilbert Burford and Mr. Joseph Masselli, authors of the section on plating wastes in the Am. Chemical Soc. Monograph 118 titled "Industrial Wastes—Their Disposal and Treatment," have called attention to rather extensive corrections required in the bibliography of that section.

In the editorial work on the section, the bibliography was shifted from a consecutive numbering system to an alphabetical order system. Unfortunately, in making this change a great many errors were introduced, particularly in that the reference numbers in various tables of data were not changed from the original system.

The authors regret this confusion but must disclaim responsibility, since they received no proof before publication. An errata sheet has been prepared to endeavor to clear up the situation. Copies may be obtained by writing to M. G. Burford, Hall Laboratory of Chemistry, Wesleyan University, Middletown, Conn.

COMMENTARY

There is Work to be Done!

Water-works men may be proud of accomplishments but should not be complacent

by JOHN H. MURDOCK, Jr., Vice-Pres. and Counsel, Amer. Water Works Service Co., Inc., Philadelphia, Pa.

WATER works officials have great reason for pride in accomplishments. Those who can remember and compare water supply and health conditions as they were fifty or sixty years ago with conditions today, can testify to improvements which justify each of us in the feeling that we have had some part in creating an urban civilization—a civilization which allows us to live in reasonable safety from water-borne disease. Through the distribution of pure water under pressure we have saved our communities and made possible their growth in population and industry. The Amer. Water Works Assn. has played a leading part in advancing better waterworks practices and in bringing public water supplies to more and more people. There is certainly ground for all of us to feel proud of our life work.

There is a great danger, however, in this feeling of pride. We tend to become conservative to the extent that we feel that no changes in our art and no new discoveries are needed in the science of water supply. We go beyond the position that suggested changes are impossible dreams and come to the point where we believe that conditions are now so good that they need not be improved. We are in danger of becoming so wrapped up in pride of past accomplishments that we become complacent and refuse to see areas in which improvements should be made. Mental stagnation and atrophy of the power to drive ahead toward ever widening horizons of worthwhile public service are the inevitable result of such complacency.

Is there room for improvement in public water supply service? Are there places in our field for young men of imagination, courage, and skill, or will we tell them —all wisdom will die with us?

What Is Adequate Supply?

Too many of our communities faced water supply difficulties last year; too many had to enforce regulations forbidding all but the most essential of water uses. In too many instances, the officials watched with anxiety as available supplies dwindled while heat and drought added to public demand for water. Public pleas for popular understanding, forbearance and restraint had to be addressed to people who were watching expensive shrubbery and valuable gardens wither and die for want of water. Businesses were handicapped and suffered losses because of lack of water. In some cases, disaster was averted only by the use of unsatisfactory sources. There have been enough of such cases and some of them have recurred often enough to have them constitute a real challenge to us.

"We tend to become conservative to the extent that we feel no changes in our art and no new discoveries are needed in the science of water supply."

What is an adequate supply? Is an adequate supply one which is sufficient to meet the normal summer loads in years of average rainfall but which is not sufficient to meet even those needs in a drought year? If the minimum safe yield of the water supply sources is not sufficient to give the customers the water that they want when they want it, is that water supply adequate? Those questions cannot be answered either yes or no.

Assume that the supply is large enough to supply customer uses for nine out of every ten years and that, to meet the needs of that tenth year, proportionately very large capital expenditures for additional supply works would be required. Many communities might well decide that the inconvenience and dangers of a depleted supply in the tenth year would be far outweighed by the increase cost for the nine years. Other communities might decide just the reverse. Public opinion, formed after free discussion and after advice from water works experts, must be counted on to give the answers. It is suggested that we need some well-defined phraseology to describe the degrees in which water supply meets customer needs.

Assume now that a community has a developed supply which is fully sufficient to meet the present peak demands of customers even in periods of below average rainfall, and that such a supply system has imposed financial strains on the enterprise or the town. Should rate inducements be held out to a prospective customer who would use up a large part of the rarely used margin of safety of supply? The incremental cost of supplying the new customer will be less than the prospective revenue and the margin of revenue over incremental cost will be a substantial contribution toward the carrying charges on the excess supply capacity.

The new customer may be a desirable new industry creating new employment opportunities, but the adding of the new customer will reduce the margin of safety in the supply works and bring up again the need for new capital for new works. When the new supply is created with its added capital costs there will again come the

Mr. Murdock's paper was presented before the luncheon meeting of the N.Y. Section, AWWA, New York City, Jan. 19, 1954.

"Water works officials are strangely apathetic concerning stream pollution and industrial use of water . . . There is much needless burdening of streams."

pleas to give inducements to new customers to use part of the added supply and so on ad infinitum. Our water works engineers and economists have room for constructive thinking in this field.

Stream Pollution

Water works officials are strangely apathetic concerning stream pollution and industrial use of water. Both are of great concern to us because of their impact on sources of water supply and adequacy of supply. Community and industrial waste disposal are essential to our civilized life and our stream systems must be depended upon to some extent for the ultimate carrying away of most waste disposal plant effluents. Yet, as of today, there is much needless burdening of streams with wastes, with the result that otherwise readily available sources of public water supply must be ignored and much more costly distant sources must be developed.

Our influence and our knowledge should be on the side of sound clean streams programs. Also because of the growing difficulty of securing ample supplies of potable water we should find some ways to help industry to conserve water. Our engineers and chemists could perform valuable water works service by advising an industry on how, by circulating, processing and reusing the water entering the plant, unnecessary and costly drains on the supply available to the community could be avoided.

The changing living habits of our people present problems for water works men. Formerly profitable territory with customers fairly closely spaced along the mains may now become blighted areas with very few customers or may be occupied by great housing developments taxing the capacity of the distribution system and yet getting water service per family unit at much less cost than families in individual homes using less water. Again families move into suburban areas. These families do not always have the choice between buying in a fully developed urban district or taking a property in undeveloped territory. Pressure of population growth often removes the element of free choice and forces the move into the unimproved suburbs. These people need water and they need a true sewerage system. They did not go outside the city to save money so it is a question whether they should be discriminated against in the cost of water and sewer service. Should the remaining customers be required to bear the burden of extending new facilities at present day costs into new territory with no advantage to themselves?

Disturbing Conditions

In an article appearing in "Public Health Reports" Oct. 1953, Prof. Abel Wolman called to the attention of public health officers some disturbing conditions which present problems which water works officials should help to solve. They should help to solve these problems because in a very real sense they are part of the community public health organization.

Dr. Wolman states: "All of us in public health and public administration have fallen down in two areas of effort. We have failed to develop the administrative and fiscal machinery necessary to provide the public amenities of water supply, sewerage, and sewage disposal in areas outside the political boundaries of individual cities. Efficient planning, with very few exceptions, declines as one moves out of the municipality itself into its metropolitan areas, and in turn from the metropolitan areas into the more rural counties."

Dr. Wolman also stated that in the last 12 years we have put in more septic tanks and cesspools than we took out in the previous 40 and that ". . . careful distribution of sewage among the population in certain congested areas has been eminently successful." We cannot ignore the hazards to public health in lack of proper water supplies and lack of sewers or in public water supplies in ground saturated with sewage. Some ways should be found to render service with justice for all.

Economic Studies Needed

When we consider the great need for wider distribution of adequate public water service and the present great cost of such widening, we must question whether the final answers have been found in the materials and methods to be employed. What we now use has stood the test of hundreds of years of use and should not be too hurriedly put aside. However, they were new once and displaced the less good. Modern inventions must not be ruled out.

There are economic studies which need to be undertaken. No matter who owns the water works, the owners and managers must face economic problems—questions of weighing dollars and cents against needed improvements, questions of sources of capital funds, questions of the relative rights of classes of customers. These are only some of the types of economic problems which need solution.

A generation ago one of the open questions in our field was the proper allocation of property and expense between general service and fire service. Many studies were conducted, testimony given and decisions made. There appears now to be a rather general agreement on the proper methods of allocation for fire service, but little use of the methods. Much remains to be done in developing a consensus concerning the proper methods of allocations in spreading the total cost of general service among the classes of customers.

How should rates be fixed for large users or for those buying for resale? We meet representatives of such customers, who will insist on rates yielding very slightly more than the incremental cost of their service. They feel that if they pay a token payment in addition to the out-of-pocket expense, of producing and pumping the water which they need, they are carrying their share of the total load. Added output does reduce the unit cost and helps to pay carrying charges but it uses up excess plant capacity and thus may add to carrying charges. Is a waterworks ever justified in offering incentive rates to bring an industry to a community? Should water ever be delivered at less than the total unit cost? How should the unit cost per thousand gallons be determined for classes of customers and for

"Are there places in our field for young men of imagination, courage, and skill or will we tell them—all wisdom will die with us?"

"Clear thinking, with a disregard of irrelevant details, but with a firm determination to reach a sound answer, will often bring success."

individual large users? There should be consultation among us and an agreed formula for answering such questions.

In establishing policy concerning extensions it becomes necessary to estimate the proportion of new revenue which will be used up in paying the operating expenses. For example, it is easy to calculate how much more fuel and energy cost will be involved in pumping the water estimated for service attributed to the extension. It will be easy, also, to calculate the additional cost for chemicals. It is probable that no additional men will be required at the station, in the office, in the outside clerical force or even in the distribution maintenance force. Thus, the added operating expense will be very small by this method, and yet, you know that year-by-year adding of customers is not accompanied by a reduction in the ratio of operating expenses to operating revenues. In times of stable prices for materials and labor the operating ratio will remain practically constant, while in times of rising prices the operating ratio will go up—in both cases in spite of adding customers. Why is it true? We don't know—we only know that it is true and should be kept in mind in considering service extensions. We need an answer to that question and we need an economic study to find it.

Depreciation Studies Needed

Depreciation presents another field for economic study. For several years the accountants pre-empted the field where regulated utilities were concerned and before that the engineers held sway. Recently economists have been doing some talking. There are many matters of fact and of policy which probably will never be finally answered but they need to be given thought by us now and over the coming years.

Several years ago this association sponsored a study of retirement experience of water works facilities. It was, and still is, the only intensive study of the great mass of available data on the subject from a large number of plants. That study was important and is still valuable but it should now be carried forward. The retirement experience data and curves should now be used to develop life expectancy curves for the same properties and facilities. Such new studies require the services of trained actuaries and statisticians. When that work is done water works managers would have some basis for fixing rates for annual depreciation—subject always to adjustment with changing conditions and advancing knowledge.

In the same general field, work needs to be done in clarifying current thinking on accrued depreciation. Is accrued depreciation, as of any moment in time, a fact established by engineering studies giving weight to all known factors which will lead to ultimate retirement—or, is it a stage in the development of reserves for the amortization of the original investment within the estimated service life? Should the annual rate for depreciation be such that the accumulated reserve over the years will tend to follow the life expectancy curves, or should the rate be calculated so that the reserve will be built up over a straight line from the beginning of service line to its assumed end? What will be the economic impact of one method as against the other?

Again economists are interested in the fact that we create a depreciation reserve sufficient to cover the cost of property retired but we replace that property item with a much more expensive one. To this extent we add dollars to our plant and property without equivalent plant enlargement. Some economists are saying that we are in a sense depleting capital by understating depreciation expense and that we should be allowed to reserve at a rate high enough to replace the property, not merely the dollars of investment. We should be giving some thought to that problem.

Economic Efficiency Yardstick

We have not yet considered the possibility of devising a yardstick by which the economic efficiency of our individual water works system could be measured. We are free of competition and so do not have that check on efficiency. Each system operates in a world of its own. The engineers can calculate the efficiency of the pumps and the coefficients of our mains can be determined. Our meters can be tested. Even on these things however there is rarely any attempt to compare results from system to system. The methods of calculating unaccounted-for water not only vary from plant to plant but from year to year in the individual plants.

Are we making efficient use of our resources or are we wasting manpower, money and materials? As stewards of our resources, we have no moral right to be inefficient. The extent to which a plant meets the service desires of its customers is never measured and, of course, plants are not compared with each other in this regard. Are our plants making the best and most economical use of the water resources available to them? Some way should be devised by which such things could be determined so that waste of manpower and of natural and economic resources would become evident and avoidable.

Ways will never be found if the searchers fix their minds on the difficulties to be overcome, to the neglect of simple fundamentals. Clear thinking, with a disregard of irrelevant details, but with a firm determination to reach a sound answer, will often bring success. "The difficult we do at once; the impossible takes a little longer."

We are living in a challenging age in this country. It is a great age in which to work. The older men among us are fortunate because as water works men they have done so much to make modern living possible and pleasant. They look back with pride and satisfaction over lives devoted to the ideal of better urban living, wider spreading urban comforts and expanding industry. They know that they have done work in an essential community effort and—if they have been awake and advancing through the years—they are proud of their life work. They have lived and they have done soul-satisfying work.

Younger men are coming on and still younger ones are choosing future careers. They must decide whether the water works field is one in which they want to spend their lives. Many of them could probably take up work which would offer more money but our field offers a challenge to energetic men wishing to devote their talents to essential public service. There is much work to be done by young men of talent, courage and a sense of social responsibility.

"As stewards of our resources, we have no moral right to be inefficient."

Selection of Main Line Meters Simplified by Use of Charts

Head losses in Venturi and orifice meters determines their relative economy

by JOHN C. THORESEN, *Engineer, Builders-Providence, Inc.*
Providence, R. I.

THE selection of suitable meters for main lines, either gravity or pump discharge, is too frequently based solely on price as a determining factor. An engineering evaluation of the bidders' proposals frequently will demonstrate that choice based on price alone is definitely improper from the standpoint of economics. This does not mean that the lowest priced equipment is never warranted, but experience repeatedly has emphasized the importance of evaluating price in terms of design, specifications and performance to be expected.

Such an evaluation will include consideration of these factors: Reputation of the meter; anticipated life and accuracy; materials; workmanship; and probable cost of maintenance. It will emphasize the character of information furnished, such as size of dials and charts, uniformity of graduations, and whether graduations are direct reading in units of flow or indirect in nominal values or differentials. Most important, the evaluation will consider the non-recoverable loss of head induced by the meter.

Friction Loss of Meters

This article will deal solely with this last factor, i.e., the loss of head, or friction loss, which causes loss of pressure, or power, resulting from the insertion of the flow measuring element in the pipe line.

For gravity lines operating under low heads, the friction loss of the proposed meter should be carefully studied to determine if it would have an objectionable effect on the hydraulic grade. In a pump discharge line friction loss alone may be of no significance, but when considered together with pipe line size and hours of pump operation, the combination of these three factors may be of considerable monetary importance in a year's time.

In general, main line meters operate on the inferential principle: that

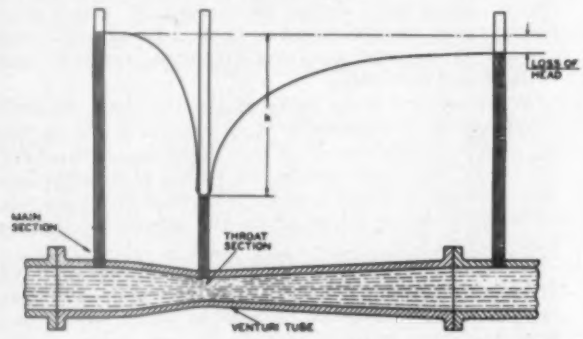


FIG. I

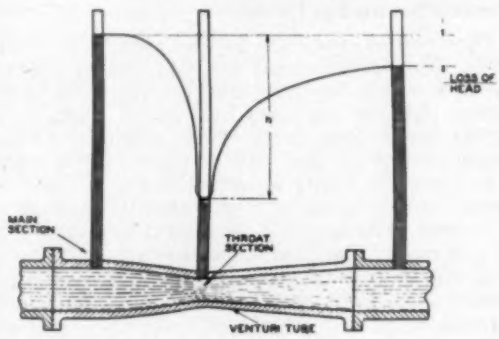


FIG. II

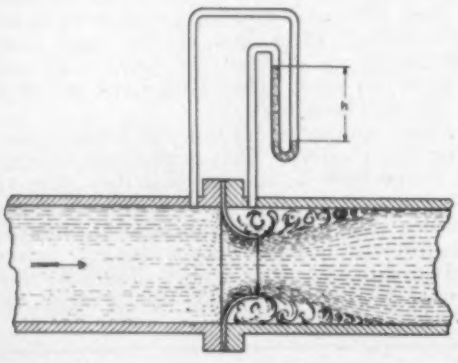


FIG. III

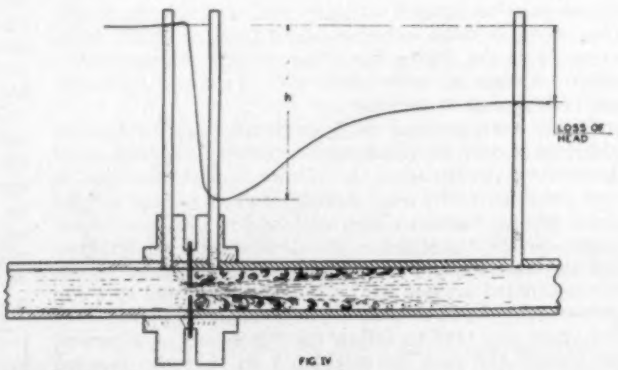


FIG. IV

FOUR FORMS of differential producers

Fig. 1—Venturi tube
Fig. 2—Venturi tube, short form
Fig. 3—Flow nozzle
Fig. 4—Flat plate orifice

is, the rate of flow is "inferred" from a difference in pressure between two points by a "restriction" placed in the pipe line, with the pressure difference transmitted to the recording instrument through which no flow occurs.

All water works men know that elbows, tees, partly closed valves, and other fittings add to pipe line friction loss and must be reckoned with in the design of the system. Meters, too, cause friction loss. Friction is important because—whether water is lifted first to a reservoir or pumped directly through the pipe line—the additional load due to friction is reflected back upon the pumps, requiring provisions for more horsepower than otherwise would be required, and power always costs money.

Differential Producers

There are only a few forms of "differential producers" for insertion in pipe lines. Figures 1, 2, 3, and 4 show the four types most widely used: Herschel Standard Venturi Tube, Short-form Venturi Tube, Flow Nozzle and Orifice. The primary purpose of each of these devices is to produce a differential pressure. This differential may be read directly and the flow calculated, or the differential may be used to drive a secondary meter which indicates the flow. In either case, from the standpoint of *efficiency* the correct basis for comparison of meters is the amount of head lost in producing a given differential.

Head loss usually is given as a percentage of the differential pressure developed. (Recoverable head loss equals 100 per cent minus the non-recoverable head loss in per cent.) For liquids of certain characteristics (large Reynolds Numbers) this percentage has been found to depend only on the geometry of the differential producer. (Note: Reynolds Number is a dimensionless figure which represents the relation between inertia forces and viscosity forces in the liquid.)

Figure 5 shows the recoverable and non-recoverable head loss, expressed as per cent of the differential for the four types of differential producers with the data being plotted against the B ratio (i.e., the ratio of throat diameter of the differential producer to the inlet diameter).

In recent years much has been learned about the mechanism of friction losses in flowing fluids. Without dealing with terms such as pressure gradient, boundary layer,

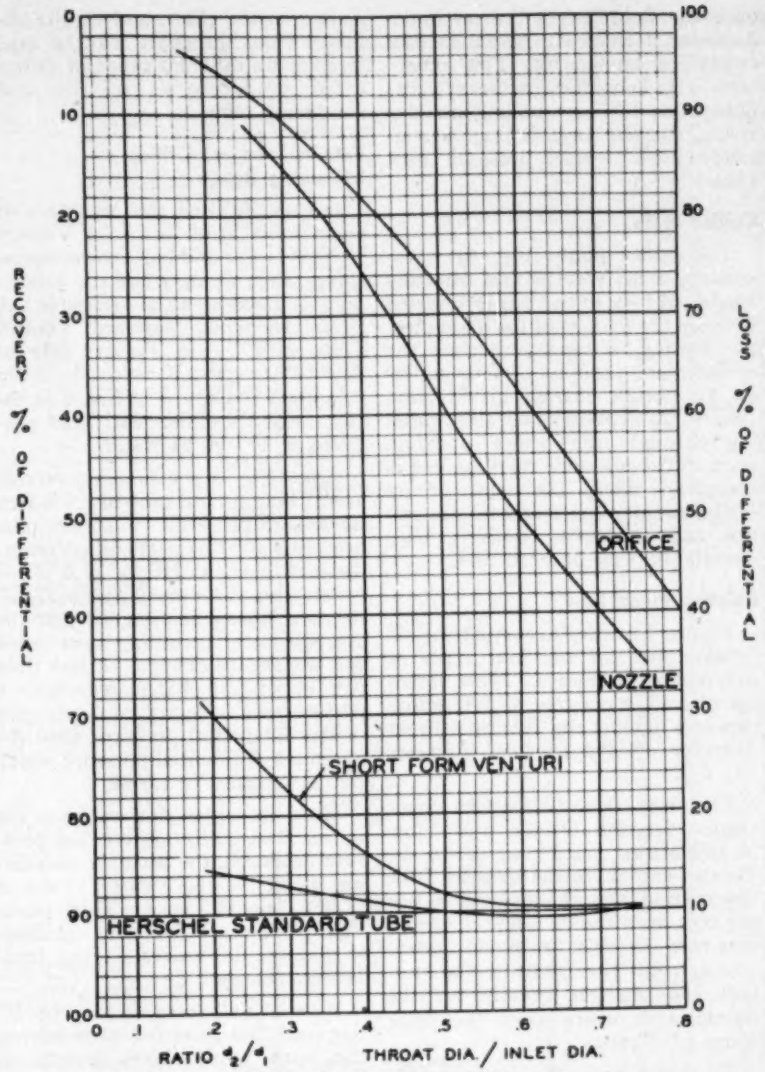


Fig. 5—RECOVERY CHARACTERISTICS of differential producers

and separation, it may be stated that the principal losses occur almost entirely in the expansion which takes place following the necessary constriction in the meter. This loss will be large if the expansion takes place rapidly and is accompanied by much turbulence, but the loss will be minimized by providing slowly diverging walls to guide the flow through a gentle expansion. (See Figs. 1, 2, 3, and 4.)

The Venturi Tube

The Herschel Standard form of Venturi Tube (Fig. 1), and the short form Venturi Tube (Fig. 2), both incorporate a "streamlined" inlet, straight throat, and gradually diverging walls. As liquid moves from the inlet through the tube there is a rapid increase of velocity with a decrease in pressure until the throat is reached. At that point the speed of flow may be ten or more times that at the inlet. After passing the throat the velocity is decelerated through a gently expanding outlet cone, accompanied by a gradual regain of pressure.

The velocity distribution is uniform across the throat and the rate of flow is based on the throat area. Throughout this interchange of velocity and pressure there is wall guidance of the flowing stream and turbulence is avoided. For this reason both forms of the Venturi Tube have a definite advantage over other devices in the important matter of pressure loss. (See Fig. 5.)

Flow Nozzle

Figure 3 illustrates one form of flow nozzle with a well rounded approach. It is apparent (Fig. 3) that

once the fluid leaves the minimum diameter it is free to form its own expanding boundaries. This expansion is accompanied by severe turbulence in the surrounding annular space, thereby occasioning a relatively high overall pressure loss. (See Fig 5.)

Orifice Plate

The orifice plate (Fig. 4) is essentially a flat plate with a carefully machined hole in the center inserted between the flanges of the main pipe. As flowing water approaches the orifice plate, the lines of flow undergo an abrupt change in direction (nearly 90 degrees) and after passing through the orifice opening, start to expand until the pipe line is completely filled. Turbulence occurs in the annular space around the orifice and causes a relatively high overall pressure or head loss.

Relative Head Loss

Figure 5 shows a comparison of friction loss for the four types of differential producers. These losses are plotted as per cent of differential pressure against the B ratio: throat diameter divided by inlet diameter (d_2/d_1).

The steep slope of the two upper curves for the Orifice and Flow Nozzle are in sharp contrast to the Venturi curves. In the Venturi Tube the friction loss changes but a few per cent over a wide range of throat diameter to inlet diameter ratios (d_2/d_1). On the contrary the friction loss changes greatly for the nozzle and orifice over the same range of B ratios.

Furthermore, the recoverable head loss is greater for all B ratios in the Venturi Tube than in either the Flow Nozzle or Orifice. In order to obtain a value of recoverable head loss in the Orifice or Nozzle somewhat comparable to that in the Venturi Tube, a nozzle or orifice of larger opening than the Venturi Tube may be used, but increasing the size of the orifice or nozzle opening also reduces the differential pressure obtainable at any given rate of flow and thus results in a lower measuring range. This may readily be determined by calculation or by use of an alignment chart.

Alignment Chart for Rate of Flow

Figure 6 shows an alignment chart for the rapid determination of flow rates, differentials, Venturi Tube throat and orifice diameters. Directions for using this chart are shown on the chart, and results obtained from the chart may be used to compare different types of differential producers as to size and measuring range.

Venturi Tube vs. Orifice Measuring Range

In order to show that an orifice of comparable head loss to a Venturi Tube is larger and has a lower measuring range we may cite the following comparison as an example: A 10-in. Herschel Standard Venturi Tube with a 4-in. throat; rate of flow=1400 gpm; B ratio (d_2/d_1)= 0.4. From example 3 in Fig. 6 in appears that the differential head produced is 240 in. of water.

From Fig. 5 the non-recoverable loss of head for a B ratio of 0.4 is seen to be 11.5 per cent. Therefore, the head loss for this particular Venturi Tube is 0.115 × 240, or 27.6 in. of water. For purposes of practical calculation it may be assumed that the average meter recording instrument will not record changes of less than 0.01 in. If this change represents a performance accuracy of 1 per cent of the differential pressure, then the minimum differential pressure which can be recorded is 1.0 in.

Since the rate of flow varies as the square root of the differential pressure produced, the accurate measuring range of the Venturi Tube is $\sqrt{240}/1$ or 15.5 to 1. This means that the Venturi Tube will accurately measure flows over a range from 1400 to 90 gpm.

By trial and error, it may be determined that an orifice plate having the same non-recoverable loss of head (27.6 in.) would have an opening of approximately 6.97 in., or a B ratio (d_2/d_1) of 0.697. For this size orifice, a flow of 1400 gpm would have a differential of 53 in. as determined from Fig. 6. From Fig. 5, it is determined that the non-recoverable head loss for a B ratio of 0.697 is 52 per cent. Multiplying this percentage by the differential (53 in.) it is possible to show the non-recoverable head loss for the orifice to be 27.6 in. and thus to check the trial and error calculation.

Since the minimum effective differential is 1.0 in., therefore the accurate measuring range of the orifice plate is equal to $\sqrt{53}/1$ or 7.3 to 1; i.e., about half that of the Venturi Tube. It will be obvious from Fig. 5 that a flow nozzle would be somewhat better than an orifice and a short form Venturi Tube only slightly poorer than the Herschel Standard Venturi Tube.

Practical Problems

Having shown briefly the relative characteristics of the two principal differential producers, we may now determine the practical significance of these characteristics as they appear in common problems met in water works practice.

Horsepower is measured in foot-pounds of work performed in a definite time period. If we raise a 50 pound weight to a height of one foot, the work done is 50 foot-pounds. By analogy, if we have 8,340 pounds of water (1000 gal) per minute flowing through a pipe line and if the head loss due to friction is one foot, the result is the same as though the water had been raised one foot, or work is being done (energy expended) at the rate of 8,340 foot-pounds per minute.

Work done or energy expended means power used, and power has a dollar value. Two practical problems may be cited to illustrate the method of determining the comparative cost of using Venturi Tubes versus orifice plates.

Problem A

FACTORS: Water pumped at 3700 gpm through a 16 in. line. Electrically driven pump with overall (wire to water) efficiency of 70 per cent. Average operating period 15 hours per day for 360 days a year (5400 hours). Power cost 2c per kwh.

VENTURI TUBE: A 16-in. Herschel Standard Tube with 6½-in. throat. B ratio (d_2/d_1)=6.5/16.0=0.405. Using the Alignment Chart (Fig. 6), it may be determined that the differential for this Venturi Tube will be 240 in. of water or 20 ft. From Fig. 5 the friction loss is determined to be 11.5 per cent; in this case equal to 2.3 ft. (0.115 × 20).

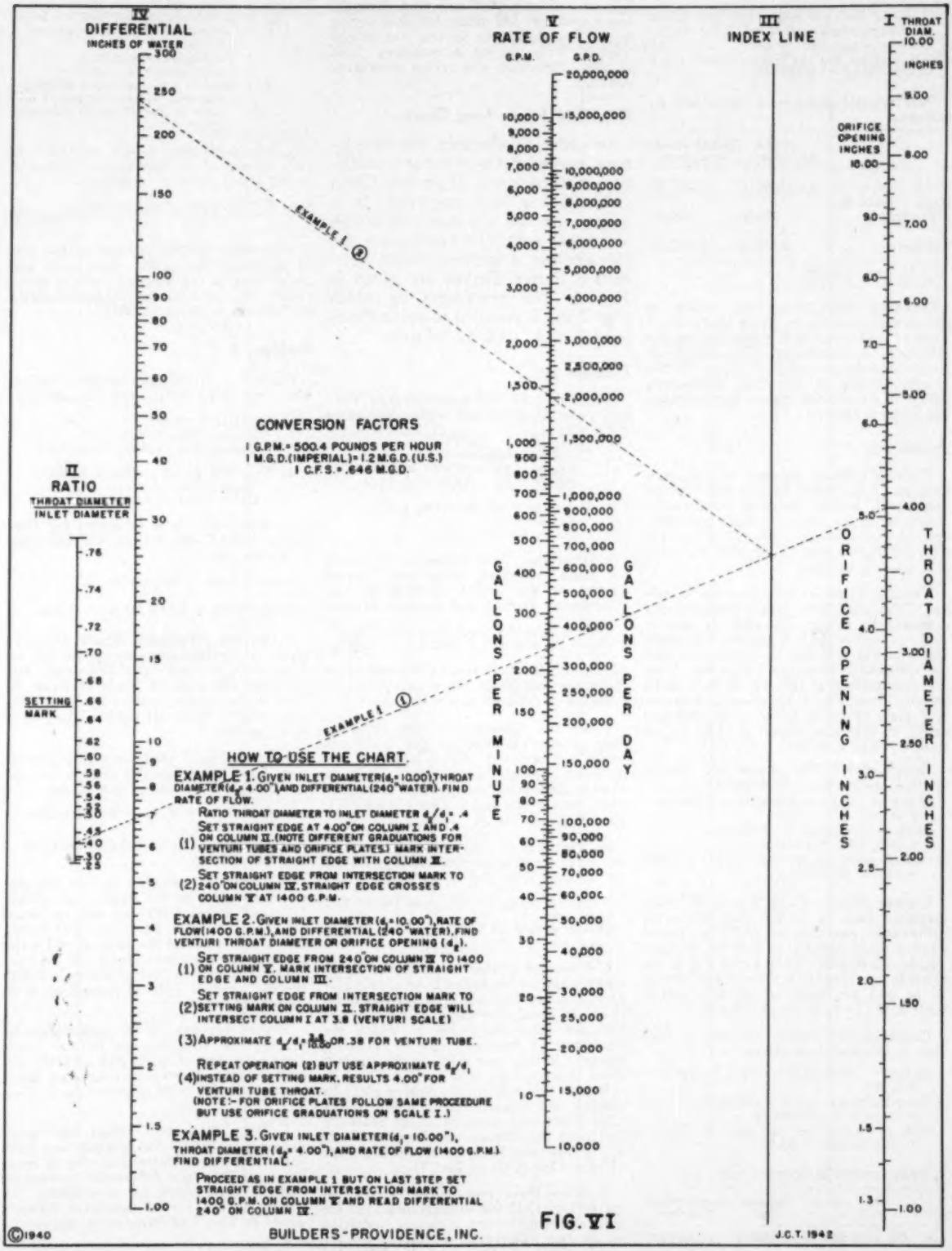
CALCULATION: The cost of power loss due to friction is as follows:

3700 gpm x 8.34 = 30,858 lb. per min
Energy loss = 30,858 x 2.3 = 70,973 ft-lb. per min
Horsepower loss = 70,973/33,000 = 215 hp
Equivalent electrical power loss = 2.15 x 0.746 = 1.605 kw
Corrected electrical power loss (for motor and pump efficiency) = 1.605/0.70 = 2.29 kw
Cost of power loss per year = hr. of operation x kw loss x cost per kwh = (360 x 15) x 2.29 x 0.02 = $247.00

ORIFICE PLATE: From Fig. 6 it is determined that an orifice plate for the same differential at the maximum flow (3700 gpm) would have an opening of 8.25 in. B ratio (d_2/d_1)=8.25÷16=0.515. From Fig. 5 the friction loss for this B ratio is found to be 71 per cent or for this orifice 0.71 x 20 ft.=14.2 ft.

CALCULATION: The cost of power loss due to friction is as follows:

Energy loss = 30,858 x 14.2 = 438,183 ft-lb per min
Horsepower loss = 438,183/33,000 = 13.28 hp


IV DIFFERENTIAL INCHES OF WATER
V RATE OF FLOW
G.P.M.
G.P.D.
III INDEX LINE
I THROAT DIAM. INCHES
ORIFICE OPENING INCHES
II RATIO THROAT DIAMETER / INLET DIAMETER
SETTING MARK
GALLONS PER MINUTE
GALLONS PER DAY
ORIFICE OPENING INCHES
THROAT DIAMETER INCHES
EXAMPLE 1
CONVERSION FACTORS
1 G.P.M. = 500.4 POUNDS PER HOUR
1 M.G.D. (IMPERIAL) = 1.2 M.G.D. (U.S.)
1 C.F.S. = .646 M.G.D.
HOW TO USE THE CHART.
EXAMPLE 1. Given inlet diameter (d_1 = 10.00") throat diameter (d_2 = 4.00") and differential (240" water). Find rate of flow.
Ratio throat diameter to inlet diameter d_2/d_1 = .4
(1) Set straight edge at 4.00" on column I and .4 on column II. (Note different graduations for venturi tubes and orifice plates.) Mark intersection of straight edge with column III.
(2) Set straight edge from intersection mark to 240" on column IV. Straight edge crosses column V at 1400 G.P.M.
EXAMPLE 2. Given inlet diameter (d_1 = 10.00"), rate of flow (1400 G.P.M.), and differential (240" water). Find venturi throat diameter or orifice opening (d_2).
(1) Set straight edge from 240" on column IV to 1400 on column V. Mark intersection of straight edge and column III.
(2) Set straight edge from intersection mark to setting mark on column II. Straight edge will intersect column I at 3.8 (venturi scale)
(3) Approximate $d_2/d_1 = \frac{3.8}{10.00}$ or .38 for venturi tube.
(4) Repeat operation (2) but use approximate d_2/d_1 instead of setting mark. Results 4.00" for venturi tube throat.
(Note:- For orifice plates follow same proceedure but use orifice graduations on scale I.)
EXAMPLE 3. Given inlet diameter (d_1 = 10.00"), throat diameter (d_2 = 4.00"), and rate of flow (1400 G.P.M.). Find differential.
Proceed as in example 1 but on last step set straight edge from intersection mark to 1400 G.P.M. on column V and read differential 240" on column IV.
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BUILDERS-PROVIDENCE, INC.
FIG. VI
J.C.T. 1942

Fig. 6—ALIGNMENT CHART for rapid determination of flow rates, differentials, venturi throat and orifice diameters for water at 60°F

Electrical power loss = 13.28 x 0.746 = 9.91 kw
Corrected electrical power loss (for motor and pump efficiency) = 9.9/0.7 = 14.16 kw
Cost of power loss per year — (360 x 15) x 14.16 x 0.02 = $1529

EVALUATION: Respective costs are as follows:

	Original Cost	Annual Power Loss Cost
16-in. Venturi Tube	$1760.00	$ 247.00
16-in. Orifice & Flanges	299.00	1529.00
Difference	$1461.00[1]	$1282.00[2]

(1) In favor of Orifice
(2) In favor of Venturi

Omitting depreciation, the saving in power consumption by using the Venturi Tube is equivalent to 87.7 per cent on the difference in investment. The savings on power consumption alone will pay for the Venturi Meter in less than two years, which is an obvious reason for selecting the Venturi Meter.

Problem B

FACTORS: Water pumped at 100 gpm through 4-in. line. Electrically driven pump with overall (wire to water) efficiency of 60 per cent. Average operating time of motor driven pump for 15 hours a day, 350 days a year (5,250 hours). Power cost 2 cents per kwh.

VENTURI TUBE: A 4-in. Herschel Standard Tube with 2-in. throat designed for a maximum rate of 350 gpm. B ratio = $d_2/d_1 = 2.00/4.00 = 0.5$. Using the Alignment Chart in Fig. 6 it may be determined that the differential pressure across the Venturi connections at 100 gpm is 18.75 in. of water. From Fig. 5, the friction loss for a B ratio of 0.5 is found to be 10.0 per cent; in this case equal to 1.87 in. or 0.156 ft. (0.10 x 18.75).

CALCULATION: The power loss due to friction is done as in Problem A:

hp loss = (100 x 8.34 x 0.156)/33,000 = 0.003942
Electrical power loss = (0.003942 x 0.746)/0.60 = 0.0049 kw
Cost of power loss per year = 5250 x 0.0049 x 0.02 = $0.51

ORIFICE PLATE: From Fig. 6 it is determined that an orifice with the same differential pressure of 18.75 in. would have a plate opening of 2.49 in. B ratio $(d_2/d_1) = 2.49/4.00 = 0.622$. From Fig. 5, the friction loss for this B ratio is determined to be 60.5 per cent, or for this orifice 0.605 x 18.75 = 11.34 in. or 0.945 ft.

CALCULATION: Power loss due to friction is calculated as above:

hp loss = (100 x 8.34 x 0.945)/33,000 = 0.02385
Electrical power loss = (0.02385 x 0.746)/60 = 0.02965 kw
Cost of power loss per year = 5250 x 0.02965 x 0.02 = $3.11

EVALUATION: Respective costs are:

	Original Cost	Annual Power Loss Cost
4-in. Venturi Meter	$445.00	0.51
4-in. Orifice & Flanges	87.00	3.11
Difference	$358.00[1]	2.60[2]

(1) In favor of Orifice
(2) In favor of Venturi

In this case, at a difference of power loss cost of only $2.60 per year, it would require almost 140 years for this saving to pay the difference in the cost of the Venturi Tube. From a monetary point of view, therefore, the orifice should be selected.

Simplified Power Loss Chart

In order to simplify the calculations needed for any meter installation, a Horsepower Alignment Chart (Fig. 7) has been prepared. It is easy to use and is accurate to within a few per cent. To accompany the Horsepower Alignment Chart, Correction Factor Curves are given in Fig. 8. The procedures by which Fig. 7 and 8 are used to solve Problems A and B are as follows:

Problem A

For a flow of 3700 gpm compare Venturi Tube (16 x 6½ in.) with orifice plate (16 x 8.25 in.):

1. Calculate B ratios:
   Venturi Tube = 6.5/16 = 0.406
   Orifice Plate = 8.25/16 = 0.515
2. From Fig. 8 find correction factor:
   Venturi Tube = 0.992
   Orifice Plate = 0.783
3. Determine "Inlet Diameter Corrected for Ratio." Multiply either the Venturi Throat or the orifice opening by the "Correction Factor" and a factor of two.

   Venturi Tube = 6.5 x 0.992 x 2 = 12.896
   Orifice Plate = 8.25 x 0.783 x 2 = 12.919

(Theoretically these two values should be the same and their close agreement is evidence of the accuracy of the charts.)

4. On the Alignment Chart (Fig. 7) place a straight-edge on point 12.9 on Scale I (Corrected Inlet Diameter) and on point 3700 gpm on Scale II (Rate of Flow). Determine point where straight-edge crosses the *Index Line* (Scale III). Line A ④ on Fig. 7.
5. From Fig. 5 (Recovery Characteristics Chart) determine the friction loss for the Venturi Tube and orifice plate.

   Venturi = $d_2/d_1 = 0.406$; head loss = 11.5 per cent
   Orifice = $d_2/d_1 = 0.515$; head loss = 71.0 per cent
6. Place the straight-edge on the determined point on the Index Line (Scale III) and on point 11.5 per cent on Scale IV (Loss of Head, Per cent of Differential) and determine the point at which the straight-edge crosses Scale V (Horsepower); in this case 2.15 for the Venturi Tube (Lower Line A ⑥ on Fig. 7).

   Repeat this step for the orifice plate by placing the straight-edge on the Index Line Point and on point 71 on Scale IV and read the Horsepower Loss on Scale V; in this case 13.25 for the orifice plate (Upper Line A ⑥ on Fig. 7).
7. From these two values for horsepower loss (2.15 for Venturi and 13.25 for orifice) the difference in cost of operation of the two differential producers quickly can be determined by using the following simplified formula:

   Excess cost of operation: orifice over Venturi Tube =

$$\frac{hp_o - hp_v \times K \times T \times C}{E}$$

where
hp_o = horsepower loss for orifice plate
hp_v = horsepower loss for Venturi Tube
K = Conversion factor, hp to kwh = 0.746
T = Total hours of operation
C = Cost of power per kwh
E = Wire to water efficiency of pumping unit (motor and pump) usually in the 50 to 80 per cent range

8. Substitute the values obtained in Step ⑥ and other data from Problem A in the above formula as follows:

$$\frac{(13.25 - 2.15) \times .746 \times (360 \times 15) \times \$0.02}{0.70} = \$1283$$

This value ($1283) for the excess cost of operating the orifice plate over and above that of the Venturi Tube is practically the same as the value calculated in Problem A above ($1282).

Problem B

For a flow of 100 gpm compare Venturi Tube (4 x 2 in.) with orifice (4 x 2.49 in.):

1. Calculate B ratios:
   Venturi Tube = 2/4 = 0.5
   Orifice Plate = 2.49/4.0 = 0.622
2. From Fig. 8, find correction factor
   Venturi Tube = 1.0
   Orifice Plate = 0.8
3. Determine "Inlet Diameter for Corrected Ratio," either from Venturi Tube or orifice plate.

   Venturi Tube = 2.00 x 1.00 x 2.0 = 4.0
   or
   Orifice Plate = 2.49 x 0.8 x 2.0 = 4.0
4. On the Alignment Chart (Fig. 7) place a straight-edge on point 4.0 on Scale I (Corrected Inlet Diameter) and on point 100 gpm on Scale II (Rate of Flow). Determine point where straight-edge crosses Scale III (Index Line) Line B ④ on Fig. 7.
5. From Fig. 5 (Recovery Characteristics Chart) determine the friction loss for the Venturi Tube and orifice plate.

   Venturi Tube = $d_2/d_1 = 0.5$; head loss = 10.0 per cent
   Orifice Plate = $d_2/d_1 = 0.622$; head loss = 60.5 per cent
6. Place the straight-edge on the determined point on the Index Line (Scale III) and on point 10.0 per cent on Scale IV (Loss of Head, Per Cent of Differential) and determine the point at which the straight-edge crosses Scale V (Horsepower); which in this problem is 0.0038 for the Venturi Tube (Lower Line B ⑥ on Fig. 7).

   Repeat this step for the orifice plate by placing the straight-edge on the Index Line point and on point 60.5 on Scale IV, and read the Horsepower Loss on Scale V; in this case, 0.024 (Upper Line B ⑥ on Fig. 7).
7. From these two values for horsepower loss (0.0038 for Venturi and 0.024 for orifice) the difference in cost of operation of the two differential producers can be determined by substituting the proper values in the simplified formula given in Step 7 of Problem A, above.
8. Difference in cost of operation =

$$\frac{(0.024 - 0.0038) \times 0.746 \times 5250 \times 0.02}{0.6} = \$2.63$$

This value ($2.63) agrees closely with the value as calculated ($2.57) in the above Problem B solution.

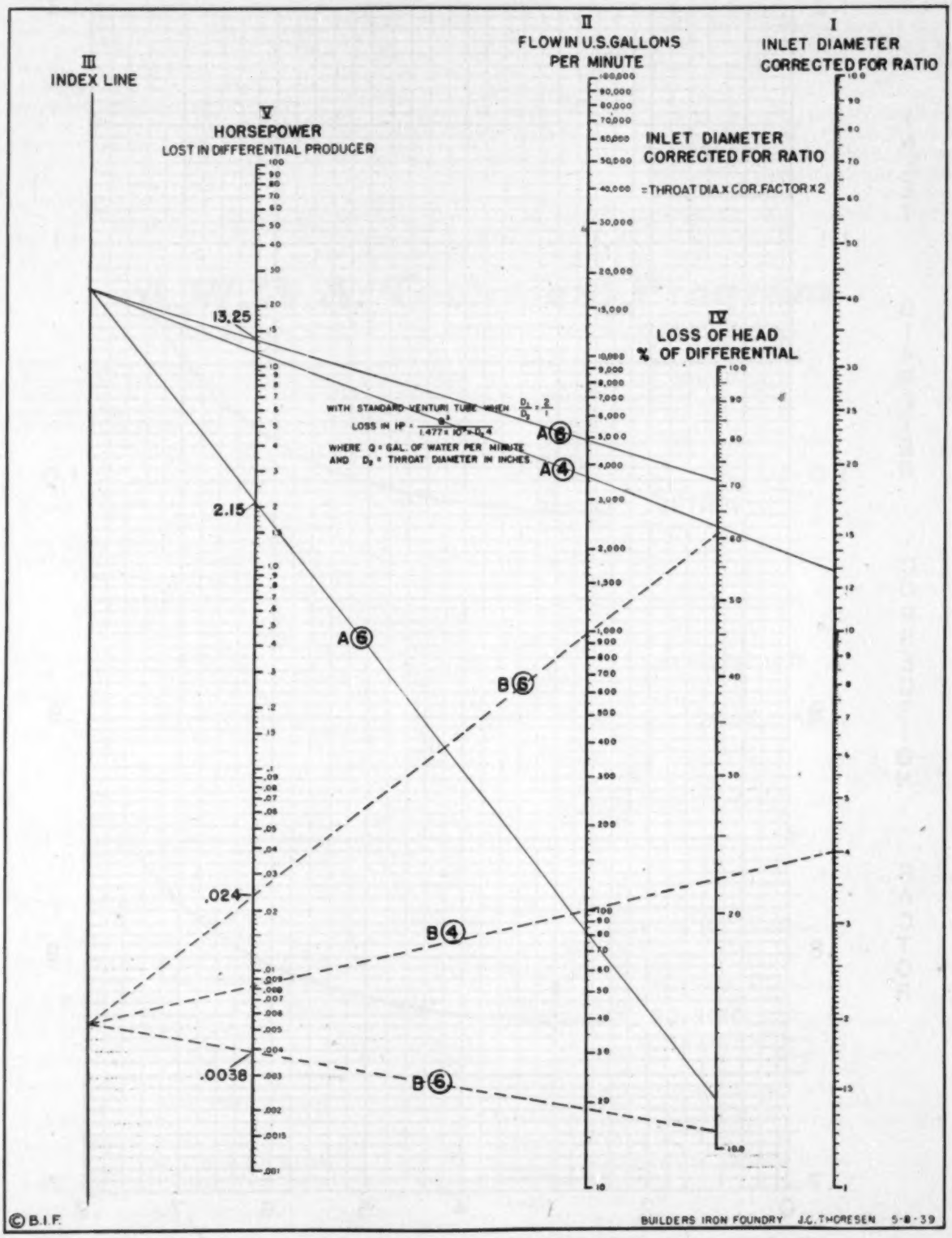


Fig. 7—ALIGNMENT CHART for power losses in venturi and other differential producers

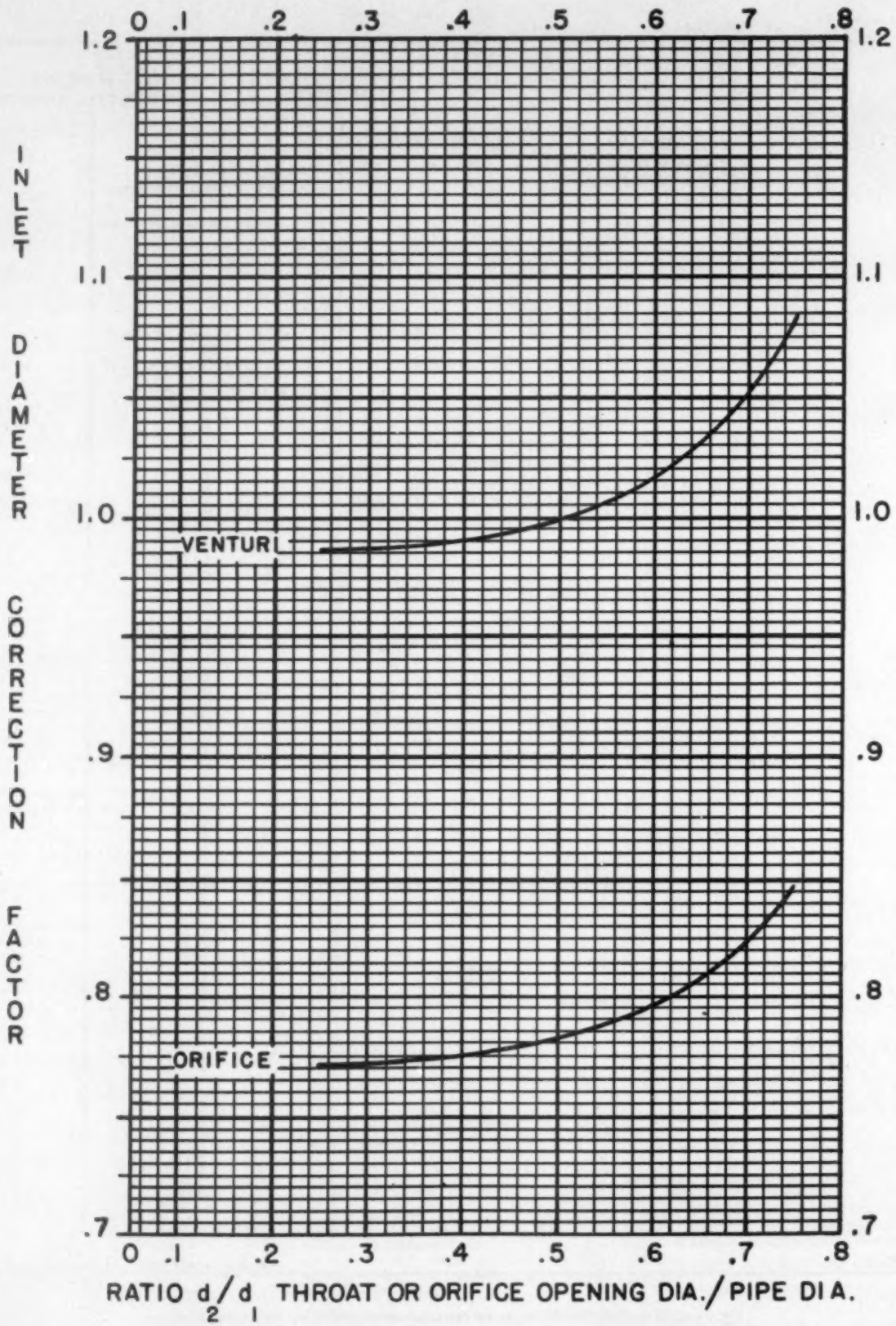


Fig. 8—CORRECTION FACTOR CURVES for use with alignment chart for power losses

Summary

1. Before selecting one differential producer over another for main line metering, an evaluation of the devices should be made on the basis of comparative cost of operation due to power loss caused by friction.

2. A chart (Fig. 5) has been drawn to show the non-recoverable head loss for four differential producers at different ratios of throat to inlet diameter.

3. An Alignment Chart (Fig. 6) has been developed for rapid determination of flow rates, differentials, Venturi Throat and orifice diameters for water at 60°F.

4. By use of Fig. 5 and Fig. 6 and simple calculations the difference in operating cost, due to friction loss, can be determined for the Venturi Tube versus the orifice plate.

5. To simplify these cost difference calculations an Alignment Chart has been developed for power losses in Venturi Tube and other differential producers. This chart and a simplified formula make it possible to determine quickly and easily the comparative cost of operation of differential producers as these costs are caused by friction loss.

6. By following the steps outlined in the "Simplified Procedure" and using the several diagrams, anyone can quickly and easily determine the most economical type of metering device for any installation under consideration.

A.W.W.A. Technical Program

74th Annual Convention, Seattle, Wash., May 23 to 28, 1954

THE following program, listing the technical sessions of the forthcoming 74th Annual Convention of the American Water Works Assn., has just been released. According to Secretary Jordan, some minor changes may be made in this advance program. All meetings and exhibits will be held in the municipal Auditorium.

AWWA 1954 Conference

Technical Sessions

Monday, May 24—A. M.

Water Resources Division

9:30 Motion Picture—Pacific Northwest
10:00 Watershed and Reservoir Control in the Northwest —Ownership, Logging Practices, Policing, etc.
Roy W. Morse, Moderator
W. A. Kunigk — *T. V. Berry*
Robert Duff — *A. E. Thompson*
C. A. Casad — *G. A. Marshall*
11:00 Seattle's Plans for the Future.....*Mayor Allen Pomeroy*
11:30 The Pacific Northwest's Resources.....*Fred Merryfield*

Monday, May 24—P. M.

Water Purification Division

2:00 Chlorination Stations—Factors in Design and Operating Control
H. C. Medbery, Moderator
J. M. Sanchis
E. Jerry Allen
Brian Shera
3:15 Water Supply at Hanford.....*W. R. Conley*
4:00 The Physical and Biological Distribution of Radioisotopes in the Columbia River below the Hanford Reactor.....
R. F. Foster
Royal E. Rostenbach

Monday, May 24—P. M.

Open Session

2:00 Water Works Practice Committee

Tuesday, May 25—A. M.

Water Resources Division

9:30 Motion Picture
10:00 The Radar Measurement of Rainfall.....*A. M. Buswell*
10:40 The Value of Water Supply Forecasts From Snow Surveys.....*Fred A. Strauss*
11:20 Weather Control Progress.....*Irving P. Krick*

Tuesday, May 25—A. M.

Water Purification Division

9:30 Business Session

Tuesday, May 25—A. M.

Water Purification Division

9:30 Plastic Pipe for Potable Water Supplies....*Walter Tiedeman*
Discussion .....*William L. Hess*
10:15 New Approaches to Control of Tastes and Odors in Impounded Waters.....*Roy E. Dodson, Moderator*
Eastern Practice .....*Benjamin C. Nesin*
Western Practice .....*R. L. Derby*
A New Method.....*J. K. G. Silvey*
11:15 Sea Water or Natural Brine for Cation Exchanger Regeneration .....*J. M. Montgomery*
Discussion .....*Eskell Nordell*

Tuesday—May 25—P. M.

Open Session

2:00 Water Works Administration Committee

Wednesday, May 26—A. M.

Water Works Management Division

9:30 Motion Picture
10:00 Regional/Metropolitan Water Systems
Abel Wolman, Moderator
Robert B. Diemer — *E. H. Campbell*
John W. McFarland — *H. B. Shaw*
H. H. Gerstein
11:00 Revenue Bonds in the Water Supply Field....*D. L. Erickson*
Discussion .....*L. W. Grayson*
George W. Francis
11:45 Local Water Systems in Reclamation Areas .....*James Howland*

Wednesday, May 26—A. M.

Water Resources Division

10:00 Business Session

Wednesday, May 26—P. M.

Transmission and Distribution Division

2:00 Motion Picture
2:30 Portland's New Supply Line.....*Ben S. Morrow*
3:00 Unusual Installations of Steel Pipe.....*Julian Hinds*
Discussion .....*Guy R. Scott*
3:45 Breaks in Petroleum Oil Pipeline Crossings Under Rivers
W. V. Weir, Moderator
M. P. Hatcher
J. C. Detweiler
M. B. Cunningham
R. K. Paine

Wednesday, May 26—P. M.

Water Works Management Division

2:30 Business Session

Thursday, May 27—A. M.

Water Works Management Division

9:30 Motion Picture
10:00 Fire Insurance Rating Problems—Panel Discussion
A. A. Ulrich, Moderator
Loren Bush — *Henry R. Herold*
Paul Braun — *R. C. Dennett*
11:00 The Utility Commissioners Standard Rules and Regulations .....*John Murdoch*
11:40 Public Relations Practices That Work!.....*Paul Weir*

Thursday, May 27—A. M.

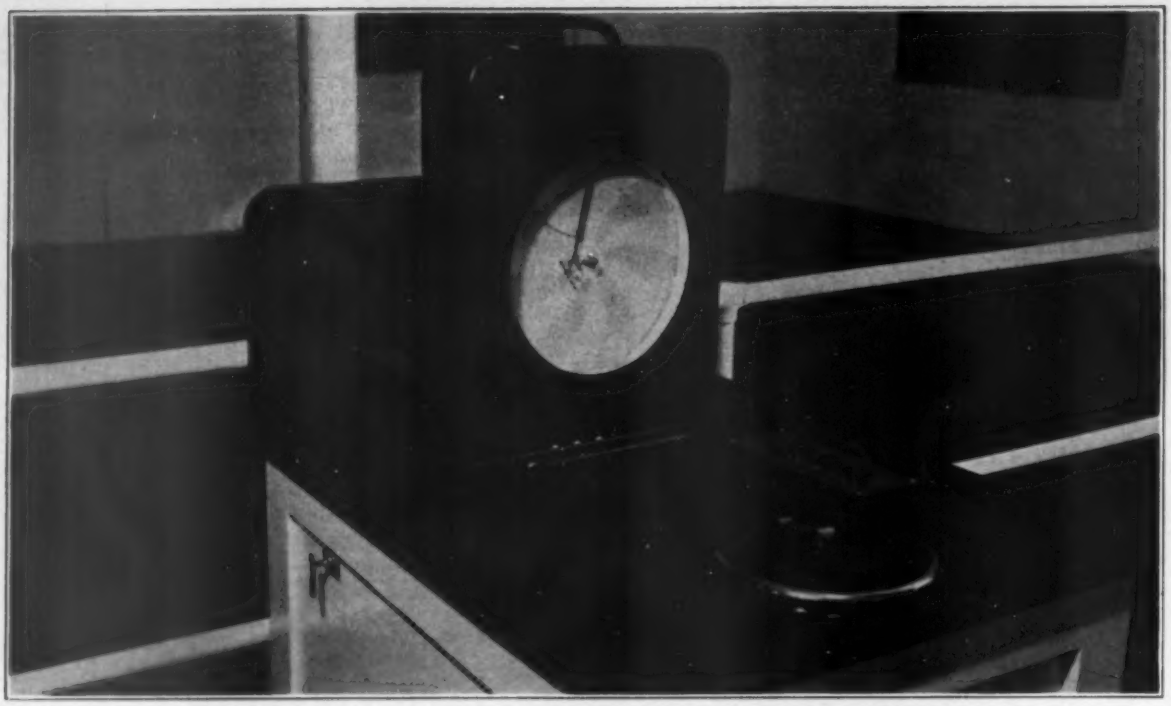
Transmission and Distribution Division

10:00 Business Session

Thursday, May 27—P.M.

Transmission and Distribution Division

2:00 Motion Picture
2:30 The Service of Wood Stave Pipe.....*John Cunningham*
3:15 What Type of Valves/Where?.....*Leslie Paul*
Discussion .....*D. W. Hopkins*
4:00 Control of Cavitation.....*W. A. Kunigk*
Illustrated Discussion.....*W. A. Tinniswood*



LOSS OF HEAD recording unit on operating table. A second unit may be connected.

How a New Loss of Head Meter Improves Filter Operation

The diaphragm cell transmits air pressure to indicate record head variations

by **W. A. GARDNER**, *Water Works Engineer*
Fieldcrest Mills, Inc., Spray, N.C.

IN THE North Piedmont Section of North Carolina lies an area which was described by Colonel Wm. Byrd, a member of the Commission which chartered the Virginia-North Carolina boundary in the year 1728, as "An Eden Land, a land of milk and honey, a place where everything grows plentiful to supply the wants of man." So enamored of the vicinity was the Colonel that he obtained title to 20,000 acres of this "Paradise" which lies in the Valley of the Dan River. Actually, it lies between the Smith and Dan Rivers at the site which now forms the Incorporations of Leaksville, Spray and Draper.

Practical business men recognized the possibilities of the area as a "production Eden" and established a number of textile mills which today still flourish. Several of the mills under a single management, the Fieldcrest Mills, Inc., group, produce fabrics of cotton, wool and synthetic fibers.

Unquestionably, one of the "plentiful" things which led the good Colonel to such effusive praise of the area was the water resources. His writings mention not only the two rivers but the numerous smaller streams criss-crossing the land. Just as certainly the good water supply was one of the factors which encouraged the investment of capital in the textile industry at the spot—as the canal, old water wheels and pump houses attest.

However, with other sources of power becoming more readily available, water was used in greater and greater quantities for processing fibers into finished fabrics, and the quality of the water became of more and more concern to the mill operators. Even as Colonel Byrd's plain milk and honey have become pasturized, vitamin-enriched, homogenized, grade-A, strained, bleached and preserved, so the water must now be given a real "spit and polish." Before the water can pass full dress inspection by the plant chemist, the wet processes of bleaching, dyeing and finishing now demand that water be prepared as carefully as for drinking purposes. Indeed, in many instances, color and turbidity requirements are more rigid than for average drinking water standards, both having to be maintained at extremely low limits.

Water Processing Plant

In 1937, with the above requirements in mind, Fieldcrest Mills, Inc., built a conventional 4.0 mgd plant for the production of processing water. This plant now supplies the nine mills. From the pump house located on the Smith River, approximately a quarter of a mile from the plant, river water is sent to the processing plant where

chlorine, alum, and soda ash are added. The water enters a four stage mixing and flocculation section, flowing from there into a square settling basin with a continuous de-sludging feature. The water flows from the settling basin into four 1.0 mgd filter units which use anthrafilt as the filtering medium, and thence to the clear well where the water is chlorinated and adjusted for pH control.

Optimum operation of any water plant generally is attained when a clear effluent is delivered from the settling basin so that the filters have little to do except polish the water: this type of settled effluent will permit a long filter run and low wash water usage. However, in the case of a surface water, the turbidity and color of the raw water can vary within wide limits. In our particular case, the Smith River source varies from 20 ppm to as high as 5,000 ppm in turbidity, and has a color ranging from about 10 to an apparent color of 1,000. As this variation may take place within a couple of hours, it is imperative that the operator constantly be vigilant for all changes. When changes occur, he must make transitional chemical feed adjustments as efficiently as possible, so as to maintain as clear an effluent water from the settling basin as possible.

Filter Operation

We are now concerned with the operation of the filter itself and what it does with the water delivered to it from the settling or sedimentation basin. The filter is a mechanical device which strains out the particles carried over from the sedimentation basin. The study of its operation has been somewhat neglected, insofar as making precise measurements of what it does and of how well it performs its functions. Actually, filter operation requires two types of measurement: the maximum rate of flow, which is governed principally by the surface area in square feet, and the length of operation which is governed by the head of water applied to the filter.

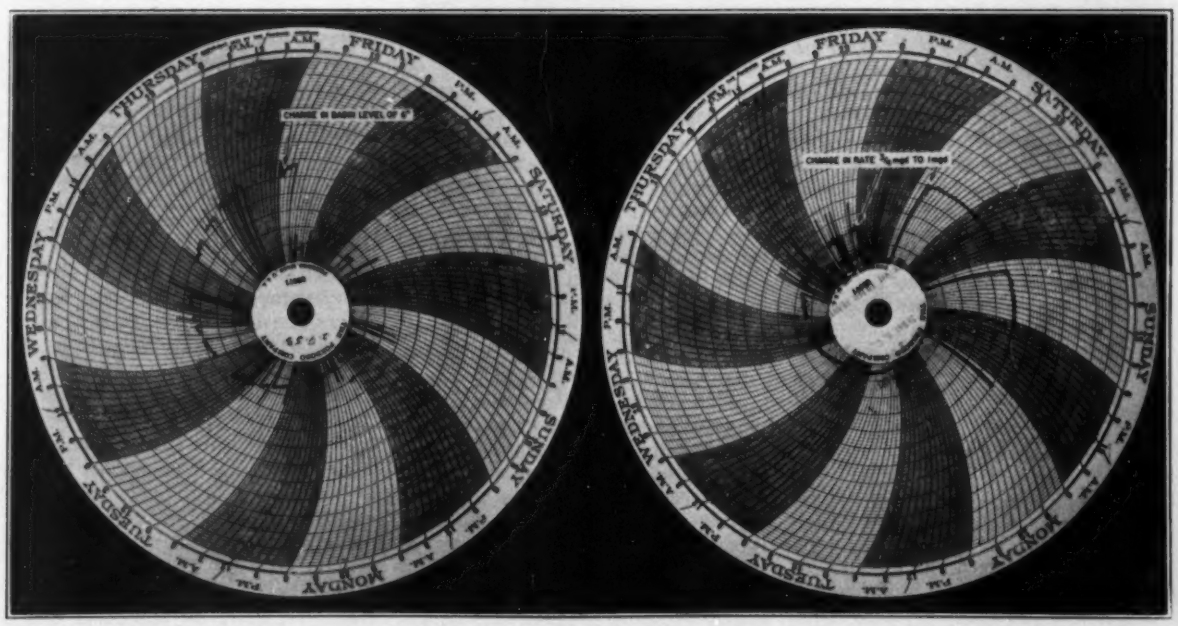
The flow rate measurement usually is expressed in gallons per minute or in millions of gallons per day. This measurement enables the operator to maintain the flow so that it will not exceed the maximum permissible rate, and to balance the water flow through the plant so that each filter will perform an equal amount of work. Each filter should have either a flow meter or flow controller (manual or automatic in operation) so as to insure that each filter carries out its prescribed work without exceeding the designed limits for efficient performance.

The second type of measurement is the loss of head. It is with the measurement of this function that this article is primarily concerned. The length of time a filter operates, within the capacity as outlined by its original design, is indicated by the loss of head. Since flocculated particles strained out on top of the filter form a barrier to the incoming water, more pressure or head is required to force the water through the floc barrier and through the natural resistance of the filter media. Eventually, if this process were carried to its extreme end point, the barrier formed by the floc particles would entirely shut off the flow of water through the filter. Therefore, the period during which a filter delivers clear water is governed by the amount of solids filtered out of the applied water. Of course, this describes ideal conditions, because filters become clogged from other than straining out flocculent particles —for example, air.

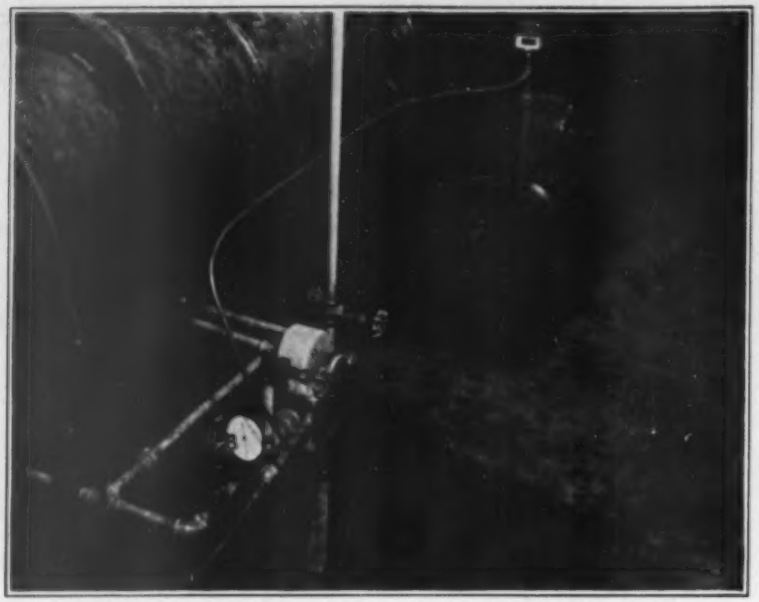
Measuring Loss of Head

Loss of head generally is measured by a simple device which consists of a vertical cylinder connected to the discharge pipe of the filter; a float within the cylinder is connected through a cable to a pointer on a dial. As the head diminishes on the discharge side of the filter, the water level in the cylinder drops correspondingly and the float indicates through the pointer the loss of head. This device measures only the discharge loss of head, and it was necessary to design a unit in such a manner that both the head on the top of the filter and the head on the discharge side of the filter will be measured simultaneously and lineally. With this type of unit, a pool or column of mercury is used to isolate one head from the other, and to permit another float, designed to float in mercury, to operate. The principal drawbacks to each of these systems are as follows:

Each time the filter is washed, it is necessary for accurate results to calibrate the unit to determine the zero



CHARTS illustrating the sensitivity of the d/p cell. Slight differences in plant operation are promptly recorded.



INSTALLATION of the d/p cell unit. Compressed air required is supplied by the small compressor visible in rear of photograph.

stop—as the device usually is calibrated with no flow through the filter. A stop is placed so as to restrict the float in one direction, the stop locating the zero point. After a filter is washed, it is very possible for the zero point to drift; therefore, for complete accuracy, the zero point should be shifted and the unit recalibrated after each filter wash.

Because of the low heads encountered in filter plant hydraulics, it is necessary to locate whatever type of metering mechanism is used in the filter pipe gallery below the operating floor. Usually the pipe gallery is not readily accessible to the operator. Therefore, if the mechanism is located in the pipe gallery, the meter indicating device usually is located as directly as possible above the meter mechanism, and on the operating floor for convenience of observation. The metering element and the meter indicator usually are connected by a small cable passed over necessary pulleys to locate the indicator in a suitable viewing point. It must be remembered that the response of any mercury float metering device is governed by the float weight and by the amount of mercury in which it floats; and in turn, the float weight must be sufficient to allow the amount of movement required. However, the greater the weight of the float the slower the response of the metering element. It can readily be seen that any device of this type to operate perfectly must drive the indicating unit through a frictionless connection—which is impossible if cable and pulleys are used.

The question naturally arises in one's mind as to how accurate this measurement of head is required to be. It has been found that the more accurate and more flexible any metering device can operate with minimum attention, the greater the efficiency of the unit being measured and controlled. Actually, in considering loss of head, we are measuring not only the performance of the filter, but also the *quality* of the water applied to the filter.

Significant Factors

Let us assume we have a specific quality of water applied to the filter: a time curve will be plotted by a recording indicator, since the loss of head will increase in direct proportion to the amount of dirt and floc particles deposited on top of the filter. As the quality of the water applied to the filter changes, the slope of the curve will become either steeper or flatter. Let us assume that a more turbid water is applied to the filter, then the time curve will be steeper in proportion to the turbidity increase. Therefore, the flatter the curve the longer the filter run and vice versa.

In the event the basin level varies, the head of water applied to the filter will show a corresponding change. A loss of head instrument capable of measuring head in inches of water will indicate the variation in basin level on the chart, and the peaks or valleys in the plotted curve will allow the operator to recognize variations in flow entering the plant.

If the rate of flow increases, the loss of head increase will be measured very adequately by the meter—as the amount of dirt and floc particles applied will be built up that much more rapidly. In summation, it may be seen that an accurate loss of head gauge will show the operator the condition of a filter, will measure increased turbidity of the water applied and, if necessary to change filter flow rate, will show the percentage of change necessary from the curve appearing on the indicating chart. In our case, we have been able to pick up several variations that had not previously been indicated by a slow-acting loss of head meter.

Instrumentation Developed

The Foxboro Co. has developed a loss of head meter which will follow variations in the loss of head to within one inch. It is based upon a principle of measurement entirely new for this type of work, has been found to be unusually flexible, easy to maintain, and highly accurate.

The primary measuring unit, called a d/p cell, consists of a diaphragm connected between the discharge of the filter and the top of the filter. This metal diaphragm is almost rigid, but can move back and forth slightly in proportion to the pressure of heads exerted upon it from the top and bottom of the filter. A very slight movement of the diaphragm actuates a lever which amplifies the movement sufficient to operate a small pilot valve and pneumatic relay.

Air is supplied to the unit by a small compressor providing a pressure of 20 psi. The d/p cell is so constructed that output air pressures of from 3 to 15 pounds of air result from the small movement of the diaphragm and lever. That is, the diaphragm moving the lever regulates the incoming air pressure from a maximum of 15 psi to a minimum of 3 psi in direct proportion to the difference in pressure across the diaphragm. Assuming that the d/p cell is set at zero for a clean filter, an output pressure of 3 pounds of air will be maintained. As the diaphragm moves (corresponding to the loss of head), the discharge pressure of the air will increase from 3 psi to a maximum permitted by the movement of the diaphragm.

The air pressure changes are transmitted through a small copper tube to a pressure indicating or recording gauge instrument. The gauge actually measures the pressure of air in psi sent to it by the d/p cell but is calibrated to read directly in head as inches of water, or any other necessary measurement.

The d/p cell is remarkably small, measuring about 8 x 4 x 6 inches. It is light enough to be supported by small piping, and may be placed where it is readily accessible (consistent with piping requirements of the metering elements).

As to operation; once the cell is set at zero, it is almost impossible to distort the diaphragm sufficiently to require resetting. It requires no mercury; therefore, no measurement or cleaning of mercury is involved. The only additional mechanism required is the compressed air supplied to the d/p cell for regulation and transmission. This air may be furnished by a small compressor such as that used in the average garage. These units are inexpensive and simple to maintain. The recording gauge may be placed almost anywhere in the filter plant, and it is quite possible to have two or more gauges on the same line so as to indicate the performance of filters at the most useful locations in the plant.

Report on Test Results

In more than one year of testing we have found that, through the use of the d/p cell, it is possible to reduce the amount of water utilized in filter washing, to maintain the filters in excellent condition, to pick up slight differences in plant chemical operations, to quickly spot excessive rates of filtration and other variation far in advance of the usual time required to ascertain these factors. Any variation in the record curve warns the operator to check successively the condition of the incoming water, the incoming rate or the outgoing rate, and quickly to correct whatever is necessary. We know it has helped us to prolong filter runs to the most desirable point. Another factor of importance is that the operator can read gauges or charts in the laboratory without the necessity of making long trips to the filter plant gallery to ascertain conditions.

A new era in filter plant operation has been opened by the invention of instruments designed to correctly measure various functions such as loss of head and flow rates, and to allow favorable location of indicating and recording devices. In the case of the d/p cell for example, the cell is located adjacent to the filter in the pipe gallery and the indicator could be as much as a thousand feet away —and is not restricted to a maximum of 50 feet of cable distance as required by older instruments.

Industry long ago demonstrated that air operated instruments pay dividends. It will be of considerable interest to note the future developments of water treatment plant instrumentation. We feel certain that some day we will be able to have filters washed at exactly the right time, and that wash rates will be materially decreased from those considered low today. We have not quite reached this millennium but we have at least taken a few steps in that direction.

Industry Reports Cost of Pollution Control Research

More than $2,200,000 is spent in the United States annually for research aimed to cut down industrial pollution, Roy F. Weston, sanitary engineer for the Atlantic Refining Co., reported in a paper presented at the annual meeting of the Am. Inst. of Chemical Engrs.

Research costs of 75 industrial firms come to at least $75,000 a year. Included are some 180 research projects which cost more than $500,000 annually. The Government spends about $450,000 a year toward the control of industrial pollution.

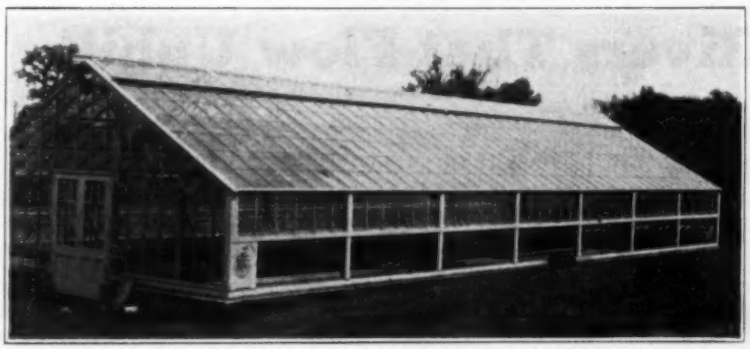
"Industry's investment in waste treatment is of the order of magnitude of $1 billion," Mr. Weston said. He pointed out 41 of the 48 States have specific water control legislation.

"The American people have spent the equivalent of $5,300,000 (1950 basis) to provide treatment facilities for reducing pollution by municipal sewage," he said. The industrial pollution load is probably greater than the municipal load at present—and will increase at a faster rate.

With this in mind, Mr. Weston urged the establishment of a research program conducted cooperatively by industry mainly because such work is "fundamentally the responsibility of industry." However, the speaker did not entirely exclude Government participation.

Such a program should supply the background of knowledge necessary to attain the primary objectives of pollution control at the lowest possible cost.

Sewage Plant Licks Breakage in Sludge Bed Glassover by Glazing with Plexiglas Acrylic Plastic



BROOKLAWN, N. J.—This sludge bed greenhouse is glazed with Plexiglas. Note one pane broken after 16 months service.

By replacing the glass lights in the roof of its sludge drying bed glassover with panels of transparent acrylic plastic, the Borough of Brooklawn, N.J., has solved a breakage problem that had plagued borough officails for many years.

The greenhouse, a standard 60 ft. x 24 ft. structure in which sewage sludge is dried prior to disposal, is adjacent to a playground area. Small boys who throw stones have found it a fine target. During the years before April, 1952, when the glass panes were replaced with ⅛-inch-thick, shatter-resistant Plexiglas, an average of 200 panes were broken annually, at an average yearly reglazing cost of $300 to $400.

As of August, 1953, after 16 months use, the acrylic plastic panels had resisted breakage to the extent that only two had been cracked, and a dull-edged triangular piece had been broken out of a single panel by a particularly heavy and sharp rock. The plastic panels, 16 x 24 inches in size, were installed the same as glass lights, using a permanently soft glazing compound along the vertical supporting ribs of the greenhouse, and 1-inch overlaps from top to bottom.

In addition to the cost savings, the freedom from breakage resulting from the replacement program has brought several concurrent advantages. Since heat loss through broken panes is minimized, the activated sludge dries more quickly. Quicker drying, plus virtual elimination of roof openings, has in turn resulted in maximum efficiency in the control of sewage odor in the community.

MENDOTA CANAL under construction. Three 15 ft. diameter pipes, upper left, now supply its flow of over 2 mg per minute.

Rivers That Flow Uphill

Developments in centrifugal pump design which make possible the transport of great volumes of water

by **HERBERT J. MEEKER,** ***Retired Asst. Vice Pres. in Charge of Public Works, Worthington Corp., Harrison, N. J.***

THREE basic necessities for modern man are air, fire and water. The first two of these generally are the simplest to obtain.

Air is all about us, and there is no tax or work involved in obtaining all we need. Hence the saying, "free as air."

In some locations the open hearth fire still is used to supply man's need for heat. The central heating system, fired by coal or fuel oil, is a comparatively modern development.

Man's need for a supply of water has been ever increasing. To meet the present day demand of domestic and industrial uses has required the construction of great works for transportation and storage of water; these are among the engineering wonders of the world, and have cost untold billions to build.

It is well known that water seeks its own level, and that the original source of all water supplies is the seas. The rains and snows that drench the earth provide water which finds its way back to the seas. On its journey this provides man with his supply of surface and underground water.

As the population of the Earth increased over the ages, man's ingenuity brought about demands for water in addition to that required to quench his thirst. Thus it became necessary to give thought to water transportation and storage, in order to provide a reserve supply during periods of drought.

Dams to impound water and aqueducts to transport it were developed by ancient civilizations; many examples of their engineering skill exist today. Storage of water at a high elevation provided for transportation of the supply to the point of use. Gravity did the job, and the principal cost was for the dam and aqueduct. Many present day water supplies have been developed on this plan.

The need for some means to make water flow *uphill* from the source of supply to the point of use became evident as large scale agriculture was developed to supply food for the increasing population, and as man settled in urban centers.

At first the water jug, filled at the well or river, brought the water as needed. Later, crude manually operated water lifts (the reverse of the over-shot mill wheel) were employed to lift the water to the desired height (in order to reach the point of use by gravity flow). Thus the pump was developed. Man's increasing demand for water, which required transportation over great distances and in immense volumes, led to the development of pumping machinery of ever increasing efficiency and size in order to move these rivers of water uphill.

Some of the most important applications of pumping equipment for supplying large volumes of water are described in this article, and the illustrations picture many interesting pumping plants.

Types of Pumps

As industrial developments ad-

vanced, liquids other than water required transportation by pumping. Some of these liquids are lighter than water, others are heavier, and some are even very viscous.

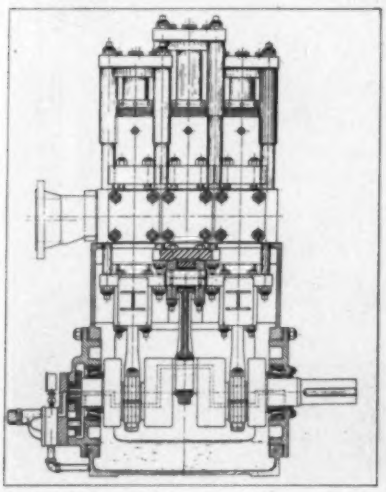
Many types of pumps have been developed to serve specific purposes. All of these come under the general classification of *displacement* or *centrifugal* types.

The first type operates on the principle of moving a measured quantity of water by a rotary or reciprocating motion. The elevation to which the liquid can be lifted is limited only by the power applied to the pump and the strength of the pump structure. The volume of liquid that can be pumped economically by a single unit displacement type is much less than that possible with centrifugal pumps.

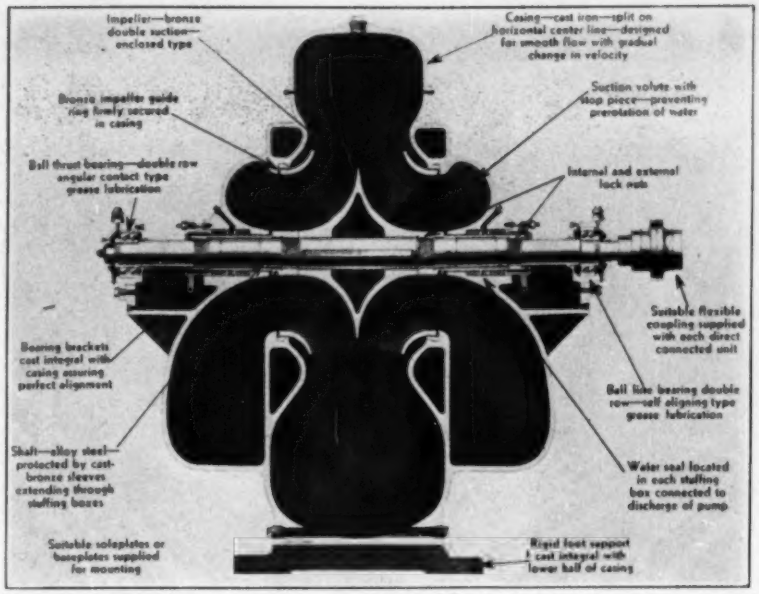
The centrifugal pump is a velocity machine of fundamentally simple mechanical design. Its development, however, confronted the engineer with many hydraulic problems that required solution before this type of pump reached its present stage of perfection.

As the centrifugal type of pump has been developed for unit capacities far beyond that of other types, it generally is used today for the pumping applications described in this article. The propeller or screw pump, known as the axial flow type, is considered to be a high specific speed modification of the centrifugal pump used for the lower head range.

Pumps of these two general classifications are depended upon for making possible practically all man's activities in manufacturing, agriculture, and in many other fields. The high standard of living now enjoyed by the Western civilizations would not have been attained without the pumps that are needed to transport water and other liquids.



VERTICAL triplex power pump shown in sectional elevation.


Impeller—bronze double suction—enclosed type
Casing—cast iron—split on horizontal center line—designed for smooth flow with gradual change in velocity
Bronze impeller guide ring firmly secured in casing
Suction volute with stop piece—preventing prerotation of water
Ball thrust bearing—double row angular contact type grease lubrication
Internal and external lock nuts
Suitable flexible coupling supplied with each direct connected unit
Bearing brackets cast integral with casing assuring perfect alignment
Ball line bearing double row—self aligning type grease lubrication
Shaft—alloy steel—protected by cast-bronze sleeves extending through stuffing boxes
Water seal located in each stuffing box connected to discharge of pump
Suitable soleplates or baseplates supplied for mounting
Rigid foot support cast integral with lower half of casing

CENTRIFUGAL pump cross section showing details of construction.

Pumping Water Supplies

There are few cities so located that potable water supplies are available which can be transported to the point of use by a gravity system through tunnels or surface pipes.

New York City has one of the largest gravity supplies in the world. Even in such a supply, pumps are needed in the distribution of the water to some of the users, and to provide the high pressure needed for fire service. Additional pumps are installed in all tall buildings to boost the pressure sufficient to deliver the water supply to the higher stories of the buildings.

Most water supplies are pumped from the source, and storage of water for future use is desirable. When the topography permits the building of elevated reservoirs, they serve not only to provide storage, but help to balance the pressure on the distribution system.

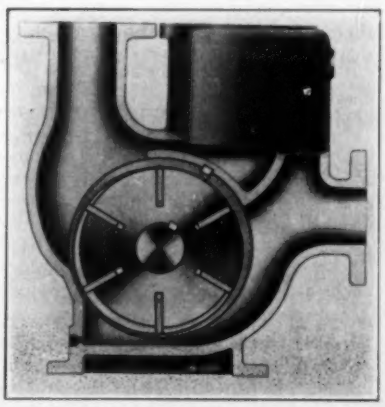
When direct pressure pumping must be used, flexibility in the pumping units is needed in order to control the rate of pumping with variation in water consumption. This can be done by using pumping units of different sizes, or by reducing the speed of the pump to operate at partial capacity.

Before the development of reliable sources of electric power, the self-contained pumping plant was essential to maintain service. Steam operated pumping machinery was therefore used in most plants. Steam engine driven centrifugal pumps usually were employed only for low service supply, and reciprocating pumps of various types were used for distribution purposes.

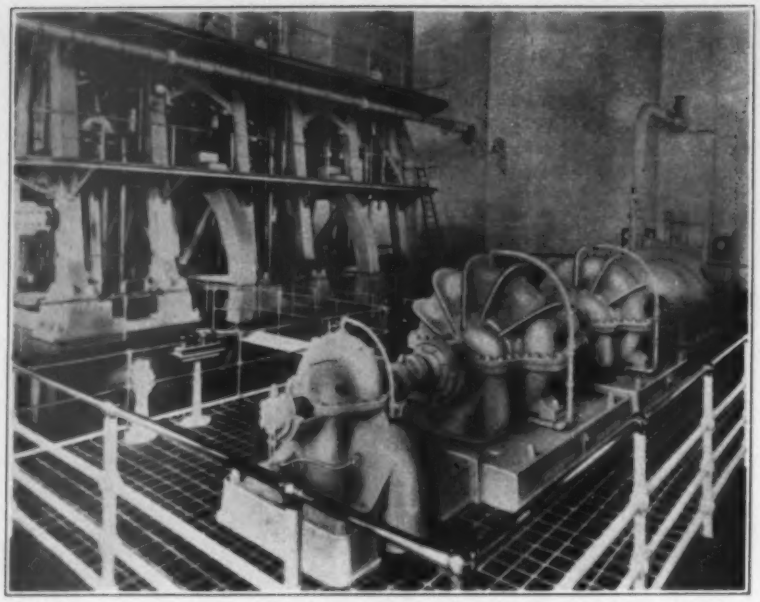
Reciprocating Pumps of Giant Size

The reciprocating pump reached its heyday in the development of the vertical triple expansion pumping engines of immense size, such as those units operated at Philadelphia, Detroit, Cincinnati and St. Louis. These were installed in the early part of the present century and some are still in use, mostly for standby service.

These giant machines, extending 50 ft. below and above the station floor, were the pride of the pump designer. The station required to house one of them approached the size of an auditorium.



SLIDING vane type rotary pump shown in cross section.



STEAM turbine driven 25 mgd two stage centrifugal water pump in Cincinnati's main water pumping station

Upper left is one of the original vertical pumping engines.

However, by constant experiment, engineers improved the efficiency and mechanical design of centrifugal pumps and that type of pump gained increasing recognition for the water end of larger pumping units. Steam was still the favored source of power. The development of quiet and high efficiency gears, concurrent with a more efficient type of steam turbine, introduced a new type of pumping unit for water works and similar service.

The demand for water grew by leaps and bounds, and larger pumping units were needed. Some turbine driven pumps were installed in old stations alongside the immense triple expansion engines. The new unit, frequently having double the capacity of the old one, required far less space. In spite of the high efficiency of the reciprocating engine, the turbo-centrifugal pump gradually made the pumping engine obsolete.

Electric Power and Motor Driven Pumps

It is now the electric age. Dependable supplies of electric power are available, not only in the larger cities but in many rural communities. The electric power utilities sought the water pumping business; as it had a high load factor, they made lower rates for this power. Electric motors of high efficiency (with speed ranges that match those needed for centrifugal pumps) made it possible to eliminate gears and to connect the pump direct to its driving motor. Space requirements favored the direct connected motor driven pump, and either vertical or horizontal shaft pumps were practical.

The motor driven pump has therefore gradually gained first place for water works service.

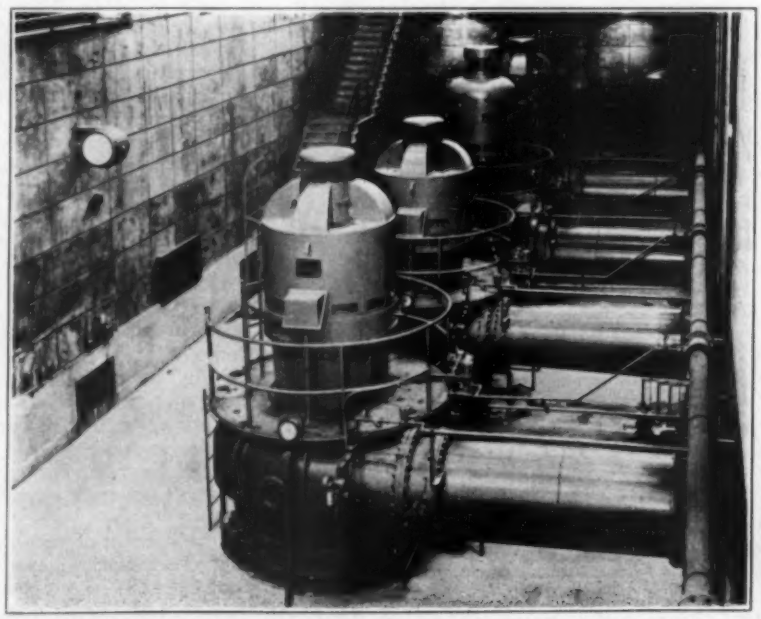
The horizontal shaft pump of the conventional double suction type has been preferred by many engineers, especially for the high service units. Where the raw water supply is obtained from a river which is subject to wide variations in level, vertical shaft centrifugal pumps have been used for many years. Long intermediate shafts between the pump and motor are needed for this setting. Care must be taken both in the design of the shaft, and in the installation of the pump.

Vertical Shaft Pumps

Vertical shaft pumps designed for high heads have been used more extensively in fields other than public water supply. In such applications, large volumes of water, comparable to water works service, are pumped. Extensive experimental work on model pumps, checked by field tests, has shown many advantages for the single bottom inlet vertical shaft pump, as compared to the horizontal shaft double suction pump.

Settings have been used locating the motor close to the pump. In some cases the intermediate shaft has been eliminated, thus directly connecting the pump and motor shaft; this is known as a close coupled unit. Such a setting eliminates the motor floor, reduces the space required, and leads to a lower cost station.

In remodeling the Bryant St. Pumping Station, Washington, D. C., ten vertical shaft close coupled pumps replaced a number of old units of various types. The units add a modern look to this old station, and provide high efficiency pumps for the several distribution



VERTICAL shaft close coupled raw sewage pumps—four of five units installed

These are in New York City's Hunts Point Treatment plant.

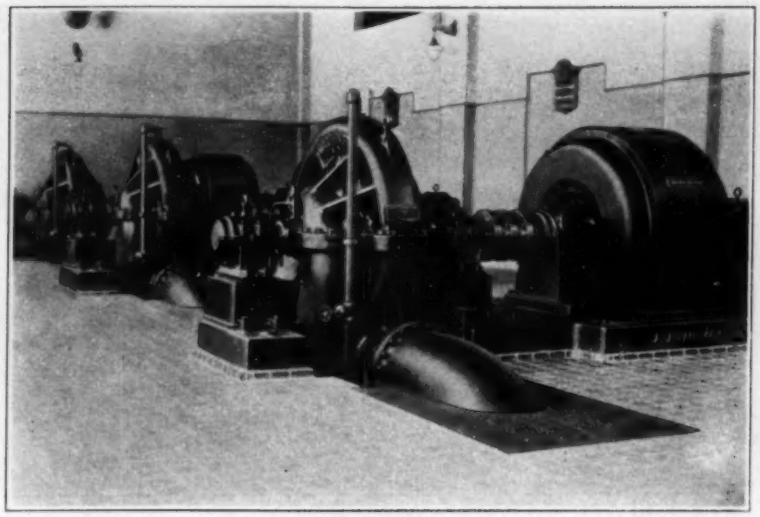
pressures served. This installation blazes a new trial for water works pumping station design, one that may well be followed in the design of new stations.

Pumping Sewage and Storm Water

After household and industrial use, waste water (sewage) is collected and disposed of. In the U.S. at the present time, about half of the raw sewage is treated before disposal. Sewage treatment in additional communities generally is progressing as rapidly as construction plans can be prepared, finances provided for, and materials made available.

The volume of sewage to be disposed of in a community exceeds the volume of water supplied, due to infiltration and runoff from storms. It is seldom that the sewage and storm water can be disposed of without resort to pumping. The pumping head usually is low (seldom above 50 ft.), but the large volume handled frequently requires pumping units of very large size.

In cities having a large area below the point of sewage disposal (New Orleans), or only slightly elevated above it (Detroit), pumping is required to prevent flooding of residential and industrial areas. New Orleans has several storm water pumping stations employing units of 14-ft. discharge diameter. The pumping head in Detroit is much higher, and each of the storm water stations in that city will require from 16,000 to 24,000 H.P. to drive the pumps when the plants are completed to operate at full capacity.

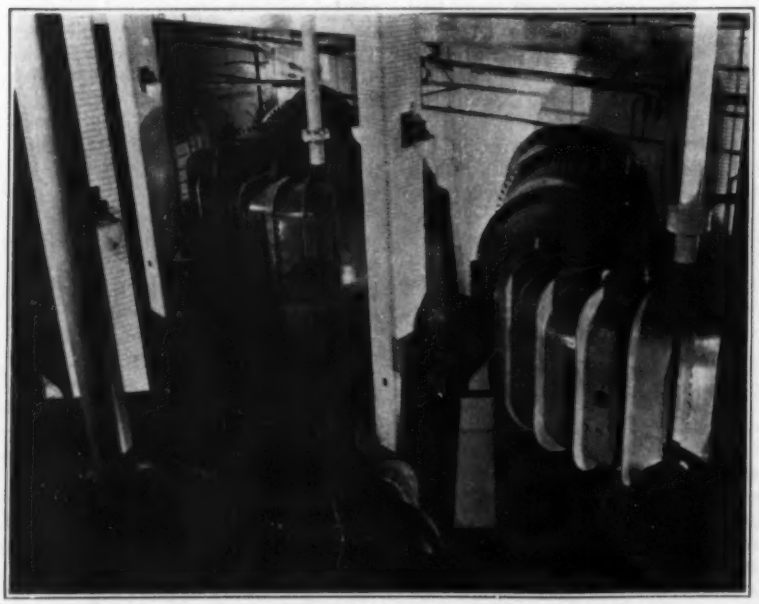


SINGLE stage 30 mgd centrifugal water pumps—three of the nine in Montreal's Atwater station

Pumping waste water containing large amounts of trash and grit, presents problems of mechanical design and selection of materials, in order to prevent as far as possible the wear resulting from erosion and corrosion. The use of abrasive-resistant materials for wearing rings, shaft sleeves and other points of wear adds to first cost, but is more than offset by the reduced cost of maintenance and outage of pumping units at critical times.

It is evident that the impeller designed for handling large amounts of trash contained in raw sewage must have larger water passages than those designed for clear water. A good sewage pump is therefore a compromise design hydraulically, and the efficiency is somewhat less than that obtained with a pump built to handle clear water.

Vertical shaft pumps are the preferred type for raw sewage service. As in the case of water pumps, electric motor drive is now most frequently used. The development of the dual fuel engine (that operates either on fuel oil, or sewage sludge gas, or a mixture of the two fuels) makes it practical to drive sewage pumps either direct from an engine or through gears.

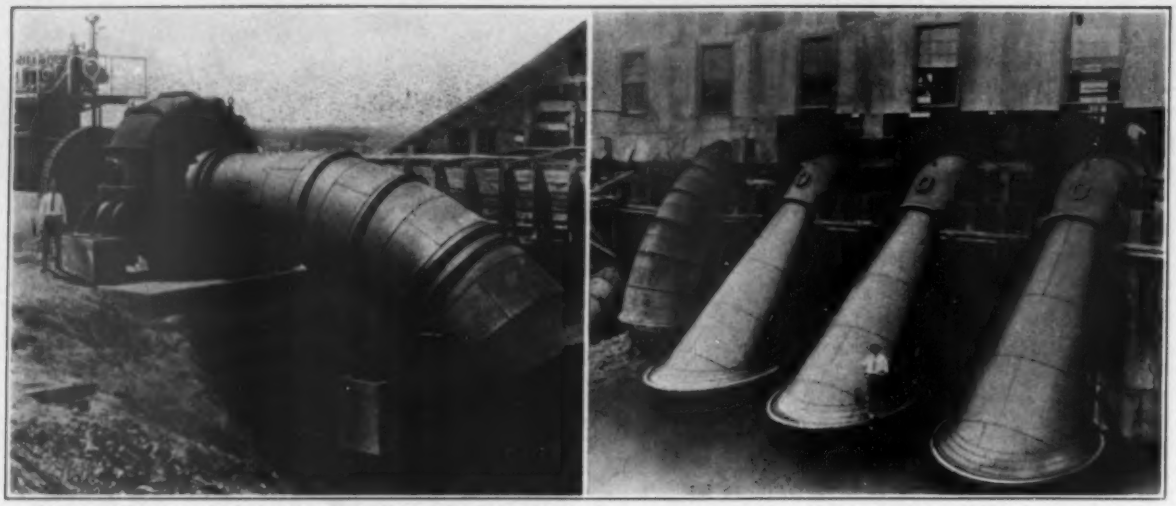


WATER pumps—a partial view of eight 84-in. diam. vertical shaft units
Detroit's Conners Creek station, having total capacity of 1.8 mg per minute.

Special Considerations in Sewage Pumping

Several recent raw sewage pumping stations have been designed for vertical shaft close coupled pumps similar to the large pumps in the Birds Island Sewage Treatment Plant, Buffalo, N.Y. This design reduces the cost of building without sacrificing accessibility or maintenance.

Sanitary engineers have recognized the need for regulating the rate of pumping raw sewage to conform as closely as possible to the rate of inflow to the station. Before the development of dependable electric power, steam engines were used in most sewage pumping stations. Where steam engines were used, it was possible to regulate the pump output by a variation in the engine speed.



IRRIGATION and FLOOD CONTROL pumping units. Left, an 80-in. diam. mix-flo centrifugal pump direct-connected to a 300 H.P. Diesel engine. Right, suction side of three 62-in. Diesel driven propeller pumps.

In installations employing constant speed motors, pumps of several different capacity ratings are used; the pumps are automatically cut in and out of service as the inflow to the sewage plant varies. In some plants a combination of constant speed and variable speed units are used.

The Nut Island Sewage Plant, Boston, Mass., is the first to use the magnetic drive, which combines the advantages of the synchronous motor with variable speed operation of the pump through the output shaft of the magnetic drive. The close regulation of the level in the wet well (within 3 inches plus or minus, which is needed for satisfactory operation of this station) is obtained with a flow control that can be either manually or automatically operated. Several other applications of the magnetic drive have been made in plants now under construction.

Pumping for Irrigation and Drainage

The need to irrigate soil when sufficient rainfall is lacking was understood by the ancients, and this need was an important factor in the development of pumps to lift water uphill. Certain parts of the world such as Holland, where an excess of water must be disposed of, need pumps to drain the land. In the Lake Ochechobie section of Florida, both irrigation and drainage are needed to keep the water table at a proper level for cultivation of the land.

Among early applications of centrifugal pumps of large size were those for pumping the large volumes of water needed in the growing of rice. Many plants of this type were installed in the rice growing sections of Louisiana and Texas about fifty year ago. Again the steam engine, which was then used for driving these pumps, has been gradually replaced in such installations with motors. Internal combustion engines also are used where oil or gas fuel is available at low cost, and where the preference is for a self-contained plant.

Irrigation and land drainage practices have progressed in many sections of the world, particularly in the Mississippi River Valley and Western United States. The large diameter, low speed centrifugal pumps that first were developed for steam engine drive have been replaced with higher speed units usually called mixed flow and propeller type pumps. These designs better match the speeds available with electric motors and internal combustion engines.

In the rather flat areas of the U.S., such as the Midwestern area, pumping heads for land drainage or irrigation seldom exceed fifty feet. Most pumping plants for these purposes are privately owned, and are operated or controlled by a drainage or irrigation District organized by a group of the residents in the area.

High Pumping Heads in Irrigation

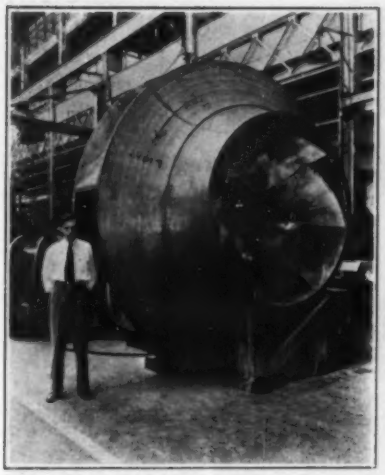
Irrigation in many sections of the Far West is a more difficult and expensive procedure. The pumping heads are much higher, thus increasing the cost of supplying the water. In fact, early attempts to develop irrigation plants sometimes ended in failure, the high water charge making it impossible for the farmer to operate at a profit.

The early plants, however, demonstrated what could be accomplished with the immense acreage of desert land if water could be obtained at reasonable cost. It was evident that the job was too big for private capital. Further, as the sources of water that must furnish the supply flowed through several states, problems of the amount of water that each state was entitled to made it difficult for the states to plan an overall project.

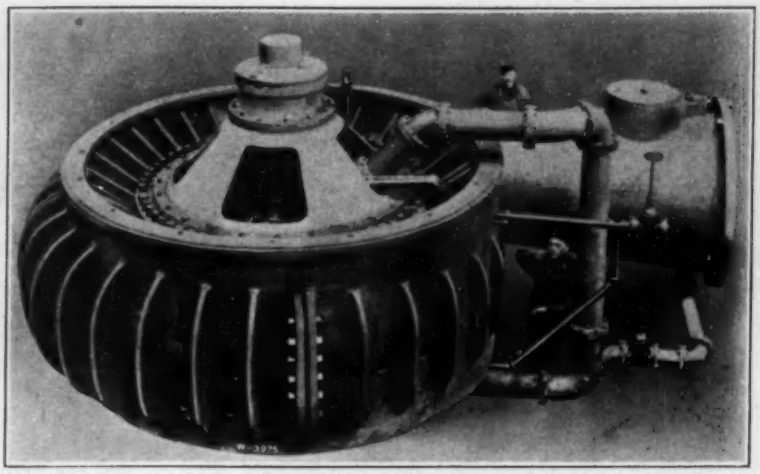
It remained for the Federal Government to take over. The Bureau of Reclamation, first known as the Reclamation Service, was organized for the purpose. Spending the billions of dollars needed to do this work could not be justified if irrigation alone was the sole objective; power, and lots of it, must be developed to lift the rivers of water uphill to the storage reservoirs. Flood control must also be considered and, where needed, river channels must be deepened to improve navigation.

Thus the multi-purpose dam—impounding immense volumes of water sufficient to irrigate the land, to generate the power needed to pump the water, and to prevent floods in the lower river valleys—is the ultimate solution for the agricultural and industrial development of the West.

In this manner, the Columbia River and its tributaries, the Sacramento and the San Joaquin, and the Colorado had to be harnessed and controlled. A large volume of their flow to the sea must be salvaged and these immense diversions from the river flow must be pumped uphill. In some cases, the pumping head is more than 300 ft. above the point where the water is diverted from the



IMPELLER, 12-ft. diam., one of three for the 84-in. centrifugal pumps feeding California's Mendota Canal.



STORAGE pump. One of two 8,100 H.P. centrifugal units for the Rocky River plant of New Milford, Conn. The storage reservoir which is fed by this pump is 230 ft. above the Housatonic River.

river. Thus, the Columbia Basin Project in Washington, the Central Valley Project in California, The Gila Project in Arizona, The Big Thompson Project in Colorado, and many others, have been organized and are in various stages of completion.

Many pumping plants and power generating plants have been built, including the two largest pumping stations in the world: Grand Coulee with six 65,000 H.P. pumping units, and the Tracy plant of the Central Valley Project, having six 22,500 H.P. pumps.

All water diverted from the Colorado River is not supplied to the Western slope. A 13-mile tunnel through the Rocky Mountains, with its eastern portal at Estes Park, carries water pumped from the Colorado to Grand Lake on the Western Slope to supply irrigation for the beet sugar country in Northeastern Colorado. On its travel down hill through the Big Thompson Canyon, enough power is developed to pump the water with a considerable reserve for other purposes.

Much has been done, and many more projects in various stages of design will be needed to complete the job. The development of the centrifugal pump, by model testing and laboratory research, made it possible to build units of immense size. Without such pumps it would not have been possible to pump these rivers uphill.

Pumped Storage

Many stations in Europe have installed pumping units combined with hydro-electric generating units. These serve to pump water uphill from the tail race to the impounding reservoir during periods of off peak load. Some of these units have hydraulic couplings permitting a quick change from power generation to pumped storage, or vice versa. Attempts have also been made to combine pumping and power generation in a single unit.

About thirty years ago the Connecticut Light and Power Co. became interested in pumped storage and built a plant at New Milford, Conn., on the Housatonic River. One 30,000 H.P. vertical water turbine and two 8,100 H.P. vertical centrifugal pumps were installed. The pumps are operated for raising water to storage during off peak loads, a steam plant furnishing the power. When there is ample water storage in the reservoir, the pump motors are used as synchronous condensers. The pumps are designed to operate dry during this period.

These pumps, of unique design, are the first high pressure pumps of large size to be close coupled. The motor shaft is extended through the pump, and the pump impeller is mounted on the extended motor shaft. The two motor bearings, one above and one below the motor, support the complete rotor; the thrust load is carried by a separate thrust bearing mounted in the motor frame.

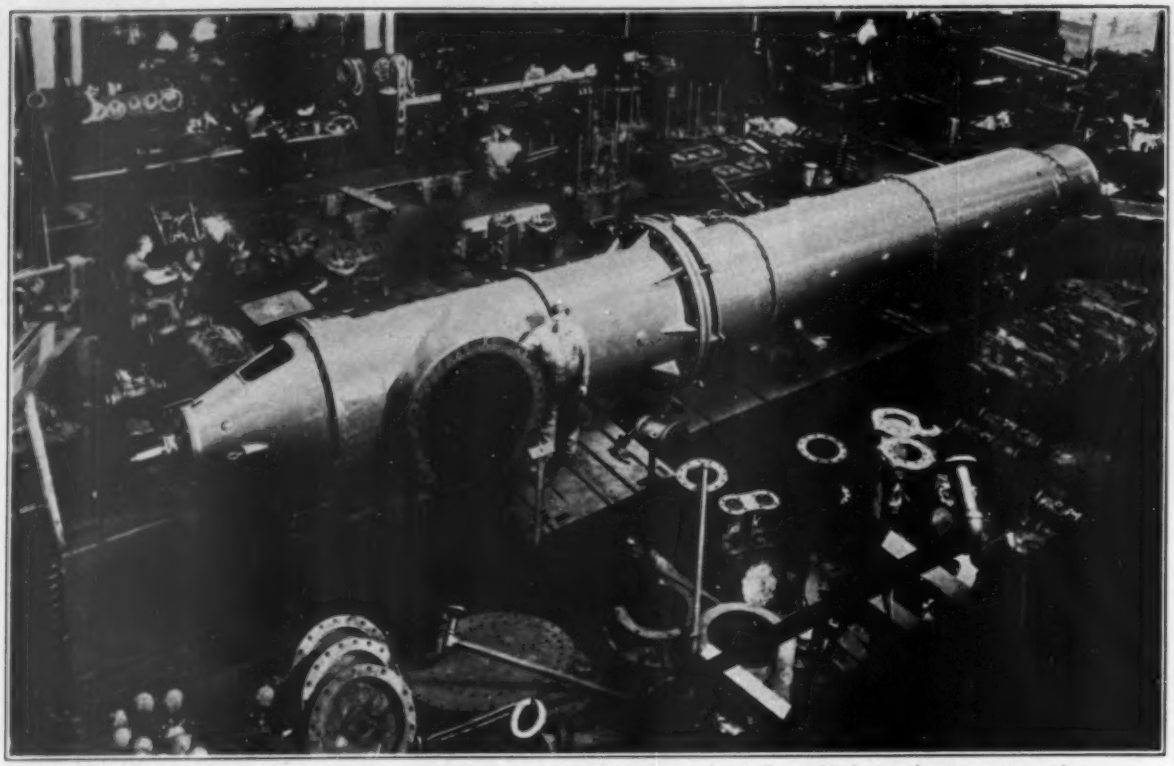
The Rocky River installation at New Milford has been successful, and similar plants were contemplated but were not constructed. Recently, however, the Lower Colorado River Authority, Austin, Texas, installed a 15,000 H.P. unit of similar design. This pump raises 360,000 gallons of water per minute to the storage reservoir located 120 feet above the tail race of the power plant. The Bureau of Reclamation, at Denver, has plans for similar pumps to be installed in certain new hydro plants.

Pumping for Flood Control

The general plan for controlling floods in a river valley includes both impounding reservoirs in the upper valley and levees along the river bank in the lower valley. It is in the lower valley that cities are located, and where valuable property including warehouses and manufacturing sections need protection against the flood waters.

It frequently happens that a river or creek which is tributary to the main stream, is the center of a highly industrialized area. A heavy local storm may flood this valley, at a time when the level of the main river is at flood stage; the local flood would defeat the purpose of the protecting levee unless means are provided to pump the local flood waters over the protecting levee into the main river.

Pumping plants installed for this purpose are for emergency use only. They usually are designed to meet the rather remote possibility of a maximum storm occurring in the valley at the time of maximum flood level in the river, in order to assure 100 per cent protection. In large cities located on the banks of rivers subject to flood (such as Cincinnati, Ohio; Huntington, W. Va.; Memphis, Tenn.; Wilkes-Barre, Pa.; and many others) several large capacity pumping plants have been installed to pump the local run-off from behind the levee to the main river. The pumps installed at Cincinnati to protect Mill Creek Valley have a total capacity of 9,000 cu. ft. per second. This is a flow of over four



CONSTRUCTION of a 54-in. vertical propeller pump. Ohio Edison power plant will use this for condensing water service.

million gallons per minute. Pumps of similar type are to be installed down river at Louisville to protect the Beargrass Creek Valley.

Many similar pumping stations have been installed, but considerable work remains to be done: the recurring floods in river valleys cause many millions of dollars damage every year. It is paradoxical that in one section of the country billions of dollars are required to provide an adequate water supply to a thirsty land. In other sections, nature provides an overabundance of water at times—and billions more must be spent to control these raging flood waters to prevent loss of life and of property.

Pumping for Industrial Applications

The applications for large capacity pumping units previously described are mostly for projects involving public works or similar service. The rapid progress made during the last decade in the development of very large and highly efficient pumping units for these projects has provided similar equipment for many industrial uses requiring large volumes of water.

The increasing demand for electric power has resulted in the manufacture of larger size power units, some recent installations having units of 150,000 H.P. More water is needed for these immense power units, both for generating the high pressure steam to drive the turbines and to condense the steam for re-use in the boilers. Larger condenser circulating pumps have therefore been needed.

Similar expansion in the need for water has occurred in practically all industrial activity. For example, steel mills use water in increasing quantities to cool the blast furnaces, also to strip the scale from steel plates by means of high pressure hydraulic nozzles.

There is a saying that "oil and water do not mix." Yet the oil industry uses many pumps to transport water, in addition to the many special pumps required to transport crude and various refined products.

The large volume of water used for air conditioning and the great progress made in air conditioning modern buildings and homes, has been an important factor in the expansion of water supplies. Atomic energy, the source of power for the future, will evidently need water in large quantities. These are a few of the important demands for increasing water supplies that require bigger and better pumps to transport the water.

Conclusion

The destruction caused by a river in flood stage, and the canyons worn through the mountains by flowing streams provide evidence of the effort water makes to flow in a straight line, and the erosive effect created by moving water containing sediment in suspension.

Information on fluid flow characteristics is, therefore, a primary consideration to engineers when working on problems involving the transportation of liquids, or the movement of a vessel through water, or of a plane through the air.

Recognition must be given to two fundamentals of fluid flow:

1. When changing the direction of flow of a stream of water or other liquid, direct the water to make this change from straight line flow with the least practical disturbance in the moving stream.

2. When a reduction in the velocity of flow is necessary, make the change as gradually as practical, and preferably where the water is flowing in a straight line.

These are old precepts, but in the design of the conventional pump of small or moderate capacity, compromises frequently are made to reduce the cost of the unit.

The velocity of flow through a centrifugal pump, especially one designed for high head, is considerably

higher than the flow in rivers. As the pump is a velocity machine, its velocity may best be compared to that of a waterfall having a height of fall equal to the head that the pump lifts the water.

It is evident, therefore, that the same compromises cannot be made with impunity when designing one of the large pumping units to cause a river to flow uphill. Thought obviously must be given to the design of the pump itself. Design of the approach channels to the pump, and the discharge connections between the pump nozzle and the main line must be considered, in order that maximum overall plant efficiency and a long wearing pumping machine will result.

Unlike the displacement pump—which moves a measured volume of liquid per revolution—the design of a centrifugal pump is not an exact science. Experience factors are needed and these factors vary for pumps of different specific speed and head ranges. Model tests, also full load shop and field tests must be accumulated over a long period and results of these tests properly analyzed in order to be a safe guide for the ultimate design of the prototypes for a large capacity pumping unit. It is evident, therefore, that the most extensive facilities for shop testing that are economically practical, are of great value to both the manufacturer and to the purchaser of pumping equipment.

Many of the installations described here are of such immense size that it was not practical to make an adequate shop test for volume pumped and power input before shipment. The design was developed from model tests supplemented by test data on pumps of a similar type.

It is a tribute, therefore, to the engineering skill of the designers and to the excellence of the workmanship in the manufacture, that these large pumps—some of which require power input of over 20,000 horsepower—show an outstanding record of successful performance. Test results have been obtained which show useful work performed in pumping water to equal 90 per cent of the power input to the pump shaft.

Man has made great progress in his ability to move water uphill. He has, in fact, attained a degree of efficiency which leaves only limited room for further improvement.

"Pull-Push" vs. "Push-Pull"

In the Nielsen Method of Resuscitation

In one of his series of articles on "Safety in Sewage Works Operation," Leroy W. Van Kleeck in our October, 1953 issue describes and illustrates the Nielsen Method of Resuscitation which is the latest approved method of those who may be considered authorities. The sequence of manipulations to be performed by the administrator of the first-aid method of getting the victim to breathing again were given.

Some of our readers have pointed out that the procedure should begin with the pressure ("push") applied to the victims back rather than with the arm lift ("pull") operation as given in the instructions and photographic reproductions on page 398 of *Water & Sewage Works* for October, 1953. Upon inquiry here and there, we were unable to say in which direction the preference for the "push-pull' over the "pull-push" manipulations was the strongest.

In consequence, we called upon the American Red Cross to help us reach a decision for publication. This is in essence what the A.R.C. advised: Although authorities contrive to disagree on the initial "push-pull" vs "pull-push" point, The American Red Cross favors the application of pressure first, followed by the arm-lift "pull" operation. Such stand is taken because it is felt that pressure applied to the upper back first helps clear the lung air passages of toxic gases or fluid, where the arm lift ("pull") operation initially causes a deeper inspiration of the gas or fluid.

We print this advice for what it may be worth, and without prejudice.

Olathe's Pipe Line on Wheels

30 Tank-Car Train Keeps Reservoir from Going Dry

Olathe, Kansas, with a reservoir all but dry as the result of the long, protracted drought, found itself in dire straits until arrangements had been made with Kansas City, Mo., the U.S. Army and the Santa Fe Railroad for water haulage from Kansas City's Turkey Creek plant to Olathe.

The first "Water Supply Special" rolled into Olathe Monday morning, February 22nd, with 30 tank-cars of imported Kansas City water. Since then the "special" has been making a round trip from K.C. to Olathe daily except Sundays. Each train load carries 314,500 gals. Through strict conservation measures Olathe's consumption has averaged 260,000 gals. daily, leaving a margin of safety.

The 30 tank-cars were supplied by the U.S. Army and the Santa Fe Railroad. A spur track runs alongside Olathe's reservoir. By quick dumping 17 cars at a time the "pipe line on wheels" is emptied in two hours and the "Water Special" is on its way back to K.C. for a fresh load at a cost of about $360 for haulage.

M. P. Hatcher, Director of Water for Kansas City, arranged a special price to Olathe for the water—namely, 7½ per 1,000 or 75 cts per tank-car of 10,000 gals. The Frisco Railroad also made Olathe a humanitarian "emergency rate" of $12.00 per car, compared to a normal rate of $22.50 per car. The cost of loading and unloading runs about $2.25 per car. The total cost to befriended Olathe was $15.00 per car of 10,000 gals, or $1.50 per 1,000 gals. delivered in the reservoir.

Not to be found in the same dilemma again Olathe's citizens have voted bonds for a new dam and reservoir being designed by Black & Vertch of Kansas City.

For the information, used as the basis for this story, we are indebted to Ralph Hull, Supt. of Utilities, M. P. Hatcher, Director of Water for Kansas City and *The Olathe Mirror*.

Shaped Wire—a Problem Solver

Water and sewage equipment utilizes this versatile material

by **RAY WARNER**, *Development Engr., Alloy Metal Wire Co. Prospect Park, Pa.*

IT'S AMAZING how many uses have been found for a little piece of wire. Wire—especially shaped corrosion resistant wire—is a versatile product, the heart of many pieces of equipment for water supply and waste disposal.

From water supply source to water filtration and sewage treatment, shaped metal wire is used extensively in the design and manufacture of modern water treatment equipment. Readily supplied in many designed shapes and sizes in a wide variety of metals and alloys, shaped wire offers many possibilities for new and advanced equipment design, enabling manufacturers to incorporate design features and improvements that might otherwise prove impractical because of costly tooling and machining.

Shaped wire is drawn through a die from a feed coil to another coil ready for use after final cleaning and annealing, if required. Shaped wire being precision drawn and rolled to specific pre-determined shape and cut to desired length, eliminates many machine operations that would ordinarily be performed by the manufacturer, thereby substantially reducing production time and costs. Since it is work-formed rather than machined into shape, shaped wire has metal characteristics which contribute to a better finished unit of equipment.

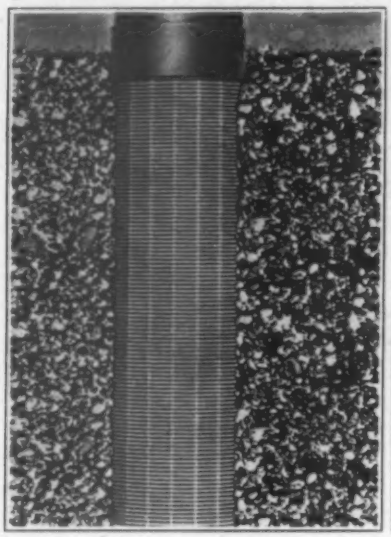


Fig. 1—JOHNSON welded well screen

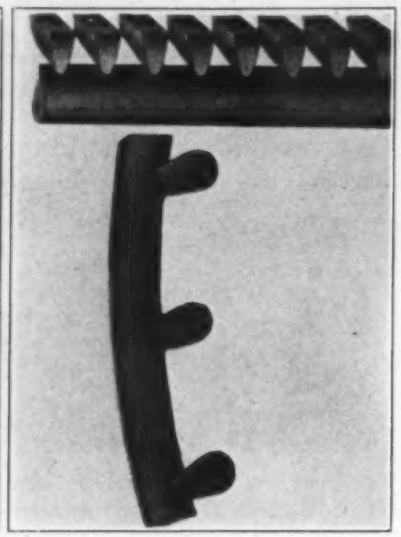


Fig. 2—SHAPED wire in the well screen

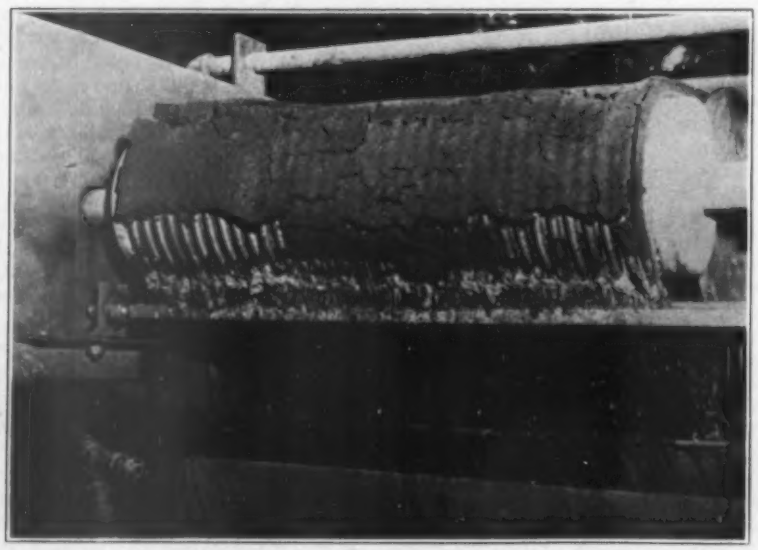


Fig. 3—KOMLINE-SANDERSON coiled spring vacuum filter

Well Point Screen Wire

An interesting application of shaped wire is found in the design of well point screen used in the development of natural, gravel-packed wells. The Johnson Welded Well Screen is shown in Fig. 1. "Development" of a natural gravel-packed well requires the removal of the silt, clay, fine sand and gravel from around the well screen so as to produce a natural filter of coarser and more uniform sand and gravel. The determining factor in the success of the well development, the design of an effective well point screen must provide for the following characteristics:

1. Maximum intake capacity to insure maximum well yield.
2. Rigid strength and durability to warrant cost of installation.
3. Resistance to abrasive action of sand and gravel and the corrosive elements in the water.

The Johnson Welded Screen permits a well to be developed to its utmost capacity due to its unique design and its immense area of intake opening. For this application, special shaped Almet corrosion-resistant wire and rod are utilized to provide maximum intake capacity, as well as the desired tensile strength required to assure the long life and rugged durability for a well screen. Wire of different composition is used to meet the requirements of each individual well installation.

The outside horizontal wrapping wire and vertical rods permit a continuous flow of water through the screen. To produce this continuous slot opening, Almet shaped wire is welded in a circumferential spiral around a special shaped Almet rod. The unique shape of both the wrapping wire and the vertical rods (Fig. 2), allows sand and gravel to make

contact at only two points on the screen, thus making it impossible for the grains to become lodged and close the slot opening. Thus, this well screen eliminates the clogging and jamming which normally impedes the efficiency of well screens.

Welding of the stainless steel wire and rod members is accomplished by means of a special adaptation of electric seam welding. As the wrapping wire touches each rod member a surge of current welds the wire to the rod. Thus welding and wrapping are accomplished simultaneously, substantially speeding the final fabrication of the screen.

Vacuum Filtration Equipment

Shaped wire has also found extensive application in the design of vacuum filtration equipment. Figure 3 shows a Komline-Sanderson coiled spring vacuum filter discharging dewatered digested sewage sludge. In this vacuum filter, wire of special shape is used to form a permanent type filter media to replace the conventional mesh or cloth filter.

Stainless steel wire, flat on two surfaces and curved on the opposite two, is coiled into springs with the curved surfaces together and the flat surfaces along the outside diameter of the springs. Two sets of these springs are laid in corduroy fashion in two layers around the filter drum, the filtration being accomplished through the helices of the springs. Cake is carried on the flat outer surface of the springs and conveyed by them to the discharge roller; air and water are directed into the external trough on the drum and removed through pipes to the vacuum and filtrate receiver.

Each spring is separate and installation of a new one is easily accomplished, a factor which minimizes down-time. Because of the long wearing durability and uniform consistency of the shaped wire, the coil spring filter has been found superior in many respects to conventional type filter media, in many instances handling sludges previously considered unfilterable with cloth-covered machines.

Shaped wire is also used to form the spiral wound deck of the continuous vacuum type filter shown in Fig. 4. Located on the outer surface of the filter drum, the wire-wound

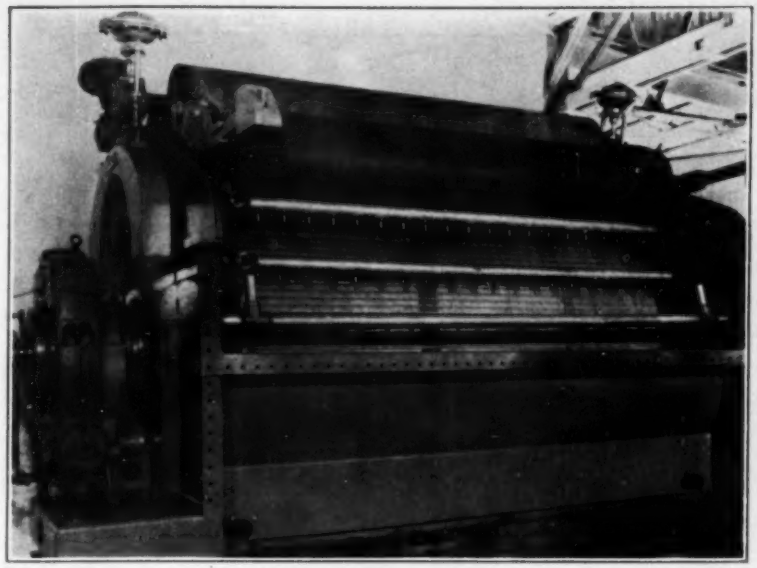


Fig. 4—OLIVER continuous vacuum filter

deck provides drainage of the filtrate to the interior where it is removed through a hollow trunion. Here the spiral also supports a wire filter screen wrapped around the perifery of the drum. Figure 5 shows the construction of this special shaped wire-wound deck. Used in the preparation of paper pulp, this vacuum type filter utilizes shaped wire of stainless steel construction to produce a rugged surface that will effectively resist corrosion usually associated with the process.

Applications of shaped wire in the design and manufacture of water supply and filtering equipment suggest additional applications for this versatile material in the water and sewage treatment. Wherever wire and rod components of unusual shape are required, shaped wire appears to offer an effective solution to design and cost problems.

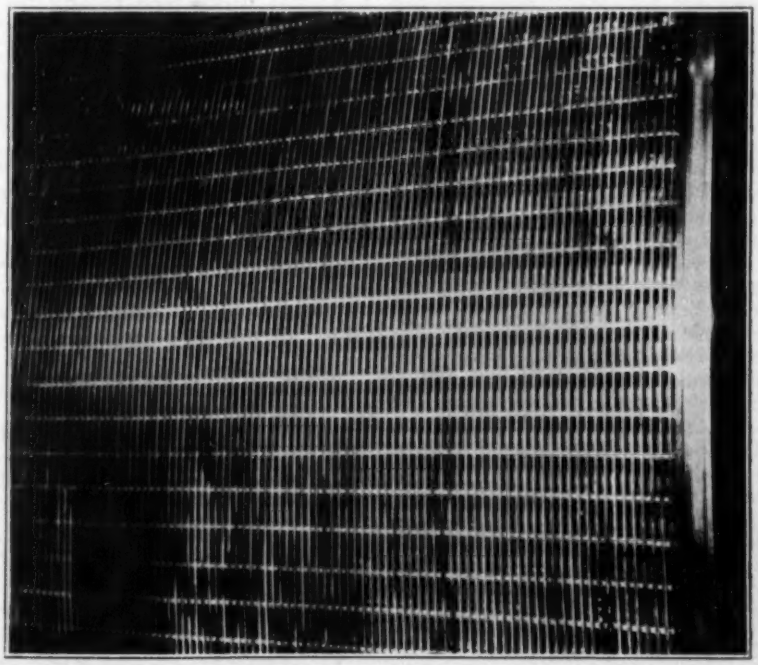
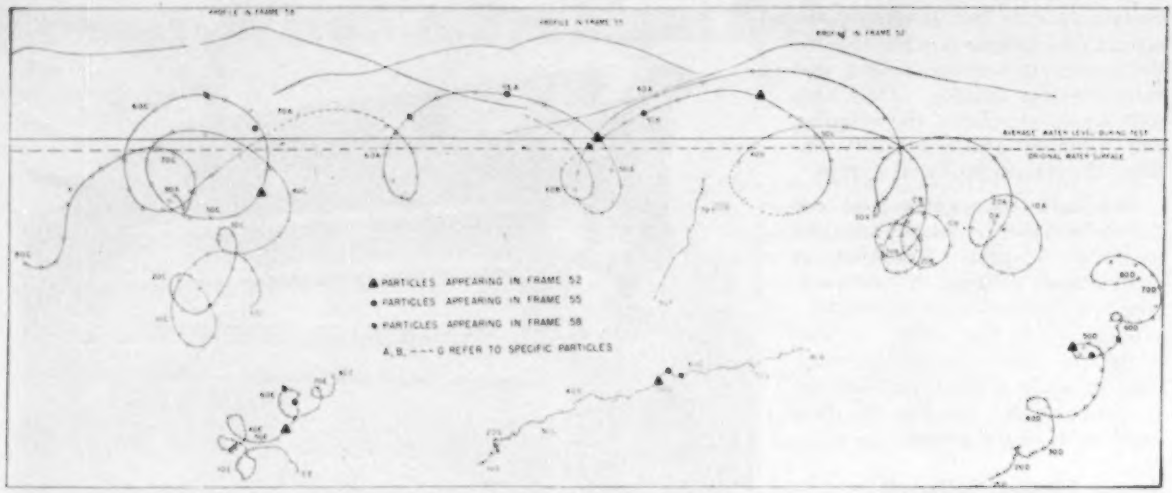


Fig. 5—STAINLESS steel wire deck of continuous vacuum filter


PARTICLES APPEARING IN FRAME 52
PARTICLES APPEARING IN FRAME 55
PARTICLES APPEARING IN FRAME 58
A, B, ---G REFER TO SPECIFIC PARTICLES

PLOT of particle paths in wave action

Waves as a Factor in Effluent Disposal

How wind mixes and moves the surface layers of large bodies of water

by **E. K. RICE**, *Engr., Inst. of Eng. Research, and* **J. W. JOHNSON**, *Assoc. Prof. of Mech. Eng., Univ. of California, Berkeley, Calif.*

IN many cases where communities are located within a reasonable distance of a large body of water (lake or ocean) it is common practice to discharge sewage effluent from the community into this water. Such method of disposal relies on the water to effect the final step in the treatment process. Most large receiving bodies of water contain sufficient dissolved oxygen to meet the oxygen demand of the discharged sewage; therefore, the problems of disposal are essentially: (a) providing adequate mixing of the sewage with a sufficient quantity of receiving water, (b) determining the time which will be available before any of the sewage matter might be returned to shore.

Submerged sewage outfalls may be one of these types: Horizontal, upward vertical, downward vertical, or multiple outlet. A horizontal discharge is slightly more efficient from the standpoint of dilution, but it is more prone to becoming clogged with shifting sand than the vertical type. In cases where an outfall pipe is carried along a pier, the outlet is often suspended from the pier and is of the vertical downward type. Multiple outlet designs have been used in an effort to obtain better mixing and dilution of the sewage with the receiving waters.

Outfall Discharge Conditions

The problem common to all types of outfalls is one of discharging the sewage effluent under conditions such that, by the time it might reach the shore, it will be both harmless and "aesthetically" clean.

Principal considerations affecting the sewage effluent after discharge into a large body of water are:

1. Factors which tend to mix the sewage effluent with the receiving water.
   - *a.* Jet mixing process due to the jet discharge of the sewage effluent into the receiving water. This mixing is the result of the turbulence generated at the borders of the submerged jet. In this process the fluid within the jet undergoes both a lateral diffusion and deceleration and at the same time the receiving water from the surrounding region is brought into motion and mixed with the sewage.
   - *b.* The oscillatory action of both ocean swell and wind waves.
   - *c.* The thermal convection and diffusion due to the temperature difference between the sewage and the receiving waters.
2. Factors which affect the size, shape, and movement of the sewage field.
   - *a.* Size and shape of the jet discharge pattern.
   - *b.* Translation by wind action on the water surface.
   - *c.* Mass transport which accompanies wave motion.
   - *d.* Local currents.
   - *e.* Spread of the sewage field due to density difference between the sewage effluent and the receiving water.

The characteristics of jet mixing including the dimensions of the jet, velocity distribution, and dilution appear to have been well established by various investigators[1,2,3]; hence a discussion of these factors is not presented herein. The discussion to follow therefore is confined to the general character of wind generated waves and their possible effects on sewage fields.

The Effect of Wave Action

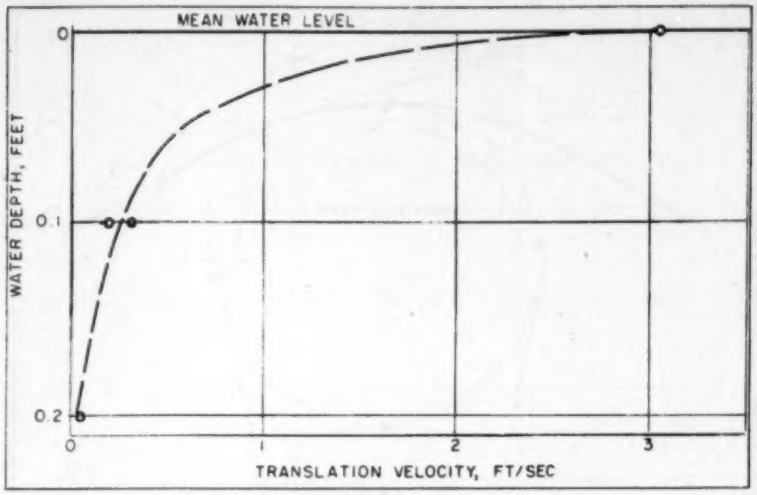
Most submerged outfalls discharge into comparatively large bodies of water (lakes and offshore along the ocean coastline) which are subject to almost continuous wave action. The action of waves is important in the design of submerged outfalls for two reasons, (1) the mixing process between the sewage and the receiving water due to the oscillatory motion of the waves, (2) the drift of the sewage field in the direction of the wave movement (generally shoreward) due to mass transport of the waves and also the translation of a surface layer of water due to the dragging action of wind on the water surface.

The waves to be considered in this report are of two general types: *wind waves* and *swell*. Wind waves are waves which are still in the generation area and are being built up in height due to the transfer of energy from the wind to the water. Swells are wind waves which have received energy from the generating winds to which they were subjected and are travelling in a region of relative calm where they no longer receive energy from the wind.

Mixing Effect in Wind Waves

The orbital motion mixing processes of ocean swell is modified in the case of wind waves by the translation, in the direction of the wind, of a surface layer of water, approximately one wave height below the still-water level. This translation is due to the action of both normal wind pressure forces and tangential shear between the wind and the water. A plot of wind wave particle motion is shown in Fig. 1 from laboratory measurements in the University of California wave channel.

Each point on the plot is the relative postion of a particle at a particular time. The time between successive positions is approximately 1/23 sec and the wind speed was approximately 42 ft per sec. As can be seen readily from the particle plot, the surface layer affected by the wind action undergoes considerable mixing and probably contains the maximum amount of dissolved oxygen which the water will hold at a given temperature. Entrained air also is present, particularly if the wind speed is above the critical wind speed (approx. 24 ft per sec). This turbulent, high-oxygen content layer of water should therefore be an excellent medium for the final disposal of sewage.

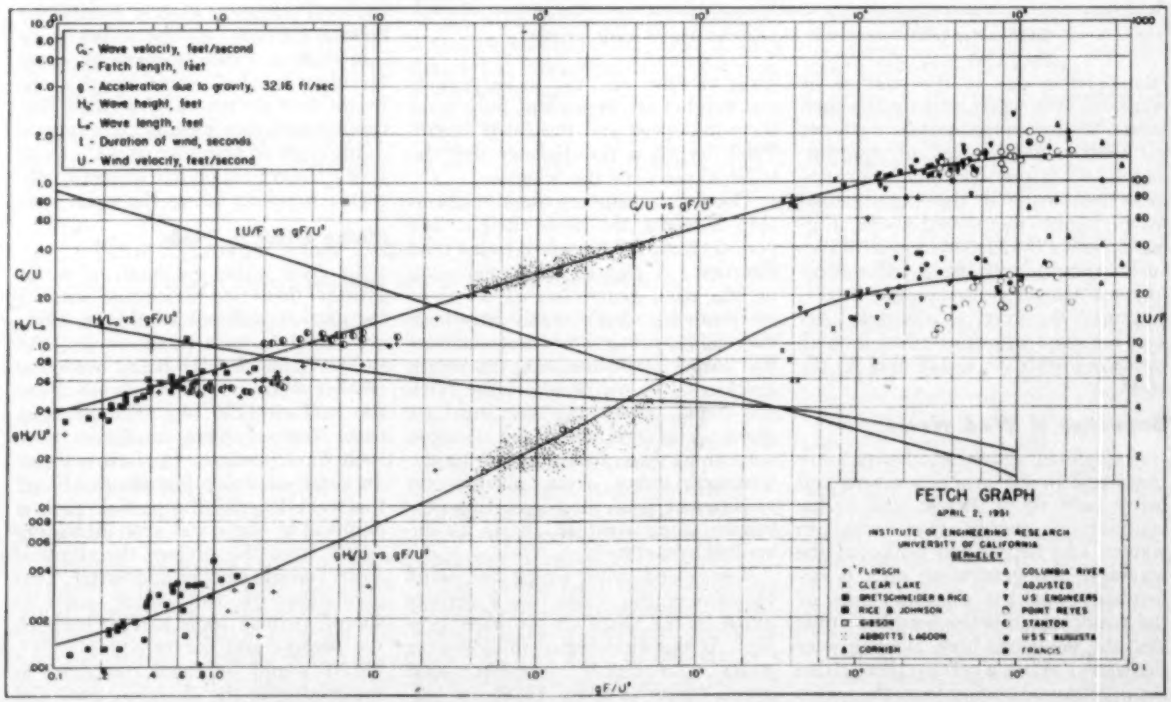


TRANSLATION velocity in feet per second
Wind vel. approx. 40 ft. per sec., wave height, 0.14 ft.

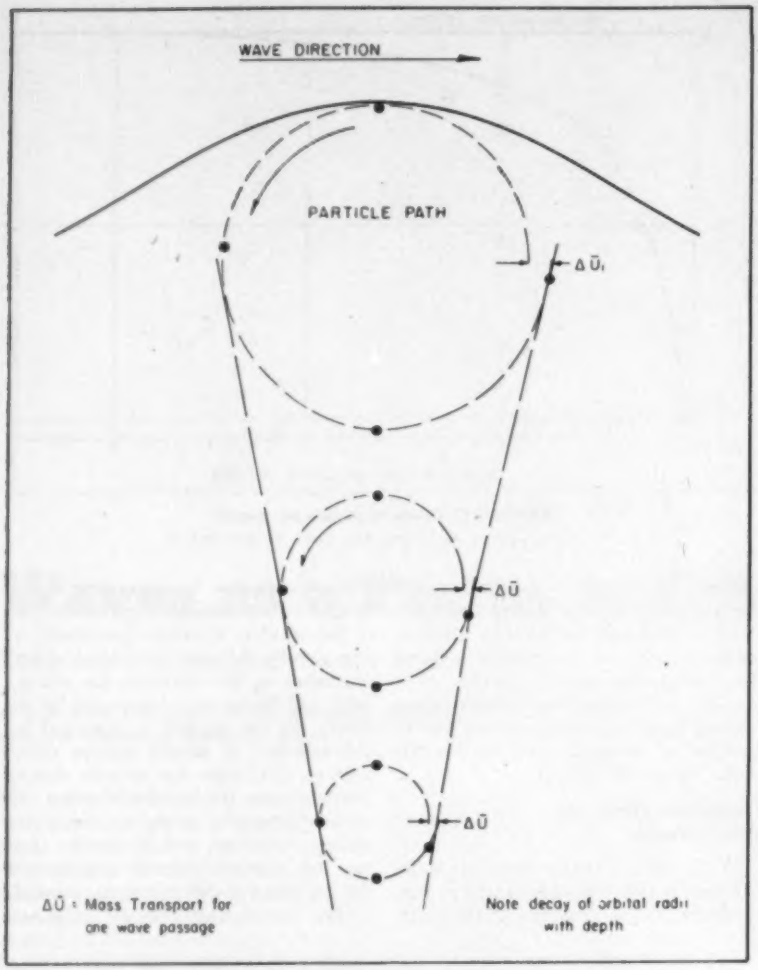
Translation Effect of Wind Waves

When wind blows over water there is considerable translation of the surface layer in the direction of the wind. This translation is important in the design of a submerged outfall in that if the wind is blowing shoreward, as is generally the case along the California coast in the daytime, the sewage field will be moved shoreward by the wind. If the outfall is operated intermittently, it would appear desirable to discharge the sewage during periods when the wind is blowing offshore (generally at night). Such discharge, however, would involve storage of sewage effluent during the day; a practice difficult to accomplish.

The translation velocity of a sur-



RELATIONSHIP between wind velocity and duration, wave height and period, and fetch



DEEP water orbital movement of particles due to wave passage

face particle due to the passage of wind over the water surface has been found to be approximately 3 ft per sec with a wind speed of approximately 40 ft per sec. This measurement was made in the experimental wave channel mentioned above. Figure 2 shows the distribution of translation velocity with depth. The effect of mass transport is included in this diagram; however, as discussed below, the mass transport effect is small compared with the direct drag of the wind.

Generation of Wind Waves

As defined above, wind waves are those still in the generation area and being built up in height due to the transfer of energy from wind to water. The height and period of the waves in the generating area is dependent upon the duration time of the wind, which is the length of time that the wind has been blowing over the water. After a certain time, called the minimum duration time, the waves reach a steady state condition with respect to time, and the wave periods and heights are dependent only upon the wind speed and the fetch length. Fetch length is the distance that the wind blows over the water.

There is a dimensionless relationship between the wave height and period, and fetch, wind speed and duration. A plot of all known data on the wind generation of waves is shown in Fig. 3. Formulas have been derived from Fig. 3 by Bretschneider and Putz[4] for determining the height and period of waves where the fetch and wind speed and duration are given. The wind speed and duration for use in these formulas can be determined either from anemometer readings or from the forecasting procedure using weather charts as described by Arthur[5].

The speed with which the wind blows over the water has a definite effect on the shape of the wave profile. As the wind begins to blow over water at a certain minimum wind speed (approximately 11 ft per second) ripples begin to appear. If the wind continues to increase in speed, the height of the waves will gradually increase up to the "critical wind speed" (approximately 24 ft per sec). Above the critical wind speed, the wave profile changes shape and is no longer symmetrical; the crest of the wave topples over and spills down the face (lee side) of the wave. This gives the waves the familiar "white cap" appearance.

Effect of Swells

Swells being wind waves traveling in a region of relative calm, no longer receiving energy from the wind, are in the decay area. On entering the decay area the waves lose energy, principally because of air resistance, and the wave length, period and velocity gradually increase and the height decreases. The shorter waves generated in the generating area have less energy and, therefore, disappear relatively quickly. The longer waves become more regular and their rests lengthen out so that in a swell coming from a relatively large distance a single crest may extend several thousand feet.

Swell is characterized by a long, smooth undulation of the sea surface. The peaking up and final breaking of waves along the coast line results from a bottom effect. When waves come into depths which are less than half the wave length, their motion begins to be affected by the bottom. The velocity and the wave length decrease, but the period remains the same, and the total energy is slightly reduced by bottom friction. As the waves move into shallow water (a depth of water less than one-half wave length), the height first decreases by a small percentage and then usually increases up to the point of breaking. It is the swell type of wave which one generally observes breaking along the coast line.

Mixing Effect in Swells

In deep water (a depth of water greater than one-half wave length) the particle paths of swell type waves are nearly symmetrical circles, the radii of the circular paths becoming smaller with increasing depth from the surface (Fig. 4). The particles make one complete oscillation with each wave passage. In shallow water (a depth of water less than one-half the wave length) the particle path is elliptical in shape and with increasing depth from the surface the elliptical paths become smaller and flatter. This oscillation of the water particles should furnish some mixing between the sewage and the receiving water, but it would be small compared to the mixing in the discharge cone and by wind translation.

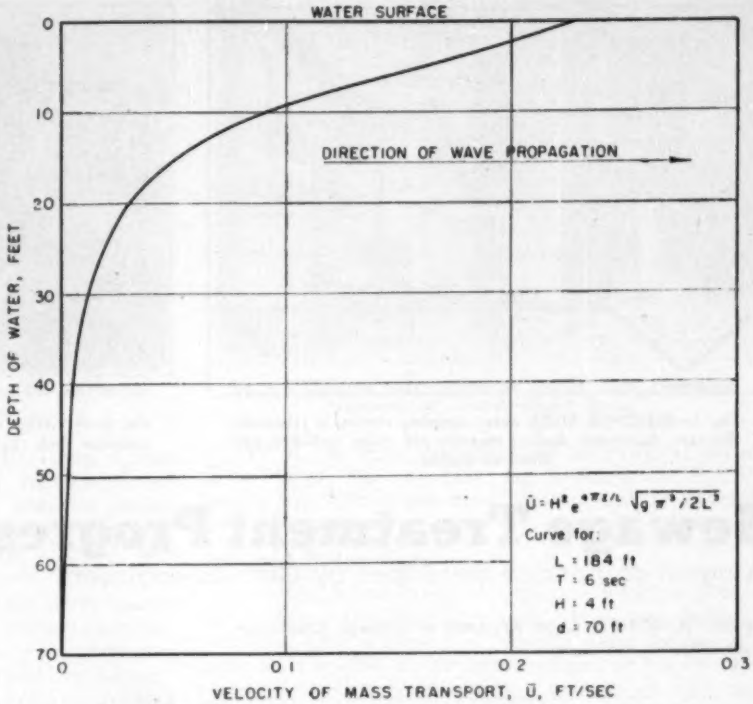
Translation Effect in Swells

There is a net translation movement of the water particles in the direction of wave movement with the passing of each swell type of wave, and this net movement is called mass transport (Fig. 4). If the actual drift of a certain particle over an integral number of cycles is divided by the length of time corresponding to this number of cycles, the resulting value is the average velocity of mass transport for the particle chosen. The theoretical expression for the velocity of mass transport is:

$$U = H^2 e^{\frac{4\pi Z}{L}} \sqrt{\frac{g\pi^3}{2L^3}}$$

Where,
U = Velocity of mass transport (ft per sec)
H = Wave height (ft)
Z = Water depth measured negatively downward from the surface (ft)
L = Wave length (ft)
g = Acceleration of gravity (ft per sec^2)

Figure 5 shows the relationship between velocity of mass transport U and depth Z for a typical ocean condition, that is, a 6 sec period wave, 4 ft high, in water 70 ft deep. Mass transport, like wind translation, is important to consider in the design of submerged outfalls, in estimating the time required for a particle of discharged sewage to travel to the beach or shore line under prevailing swell conditions.



EXAMPLE of mass transport vs. depth for typical outfall location

Conclusion

The mixing of sewage with a receiving body of water is appreciable only when waves are of the wind wave type, and then nearly all of the mixing occurs in a surface layer of water approximately one wave height in depth. Wind blowing over a sewage field will cause a surface layer of the field to be translated at an appreciable rate in the direction of the wind. Wave mass transport also translates a sewage field in the direction of wave travel, but this movement is of second order importance.

References

1. Albertson, M. L.; Dai, Y. B.; Jensen, R. A.; and Rouse, H. "Diffusion of Submerged Jets," Proc., Amer. Soc. of Civil Engrs., Dec., 1948, pp. 1571-1596.

2. Folsom, R. G., and Ferguson, C. K. "Jet Mixing of Two Liquids," Trans., Amer. Soc. of Mech. Eng., Jan., 1949, pp. 73-77.

3. Rawn, A. M. and Palmer, H. K. "Predetermining the Extent of a Sewage Field in Sea Water," Trans., Amer. Soc. of Civil Eng.; 94: 1036-1081, (1930)

4. Bretschneider, C. L., and Putz, R. R., "The Problem of Wave Action on Earth Slopes (a discussion)," Trans. Am. Soc. Civil Engr.; 116: 1409-1414 (1950).

5. Arthur, R. S., "Wave Forecasting and Hindcasting, Proceedings of First Conference on Coastal Engineering," Chapter 8, Council on Wave Research, Engineering Foundation, October, 1950.

New Sewage Plan Submitted to Los Angeles

Rawn report suggests use of County facilities

A program under which indicated that the city of Los Angeles can save millions of dollars in sewage costs by using county sanitation district methods and facilities was outlined recently in a comprehensive study furnished to the City Council by A. M. Rawn, chief engineer and general manager of the County Sanitation District.

Regarded as almost certain to start a major controversy over the city's future sewage policy, the Rawn report suggested a $22 million program for use of District facilities which apparently could be substituted in large part for a $37 million five-year "emergency" program recently advanced in contemplation of future increased use of the city's Hyperion outfall sewage treatment plant on Santa Monica Bay.

Figures which stood out in the Rawn report were a claimed immediate saving of $15,862,000 in capital outlay expenses, $10,000,000 in bond interest charges and $32,000,000 in sewage treatment charges over a period of years, three sums which total approximately $57,000,000.

The Rawn report, incorporated in a 69-page volume, accompanied by voluminous maps, charts and engineers' drawings, was made in response to a $50,000 appropriation for the purpose approved by the City Council some months ago.

Chemical Plant Water Needs to be Supplied by Sewage

The problem of assuring an adequate supply of water for a new chemical plant in an area where water supply has become a serious problem has been solved successfully by Shell Chemical Co. at its new ammonia plant in Ventura, Calif.

Shell Chemical uses 450 gallons of water a minute for cooling and steam generation. To provide all the water required, other than potable water, both for its new plant and for the nearby oil field of the parent company, a sewage treatment plant is to be built by Shell Chemical at Ventura.

The effluent available from treatment of sewage is expected to eliminate the uncertainty of adequate water supply for all Shell's operations here.

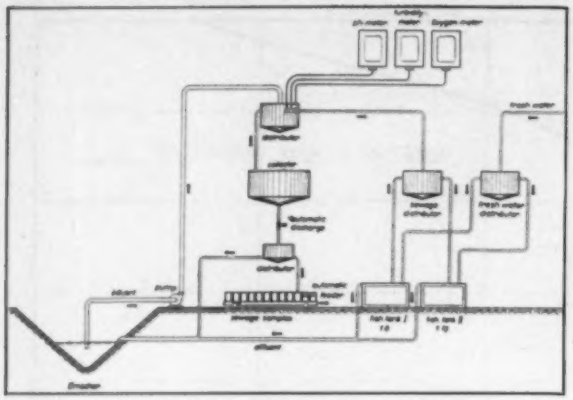


Fig. 1—EMSCHER RIVER water sampling station in schematic diagram. Automatic devices measure pH value, turbidity, and dissolved oxygen.

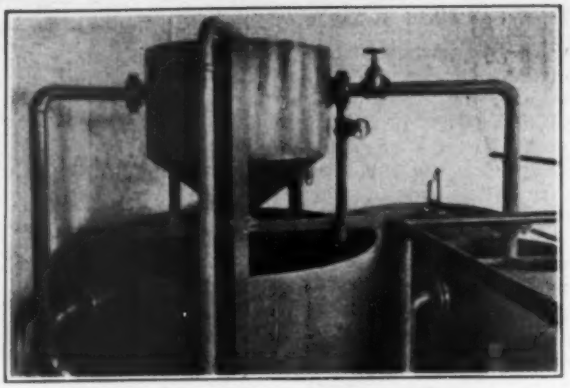


Fig. 2—PUMPED WATER enters sampling tank (top), flows to collector tank (below), and to distribution chamber and fish tanks (right).

Sewage Treatment Progress in Germany

A report on practice developed by German engineers

by DR. H. ROHDE, *Chief Engineer of Sewage Treatment, Ruhr District, Germany*

C. E. Keefer, Editorial Associate of *Water & Sewage Works*, prepared this résumé of the paper presented by Dr. Rohde at the 1953 annual conference of the Institute of Sewage Purification in Torquay, England.

Mr. Keefer is Deputy Sewerage Engineer, Bureau of Sewers, Baltimore, Md.

SINCE the sewage from only 40 per cent of the 26,000,000 people in the Bundesrepublik of Germany receives treatment, much remains to be done to improve the sanitary condition of the watercourses in Germany. It is considered that two steps are necessary: first, to increase the efficiency of sewage plants by the use of biological processes; and, second, to reduce the load on streams resulting from the discharge of industrial wastes.

Emscher Water Control Station

Dr. Rohde describes a unique and interesting method of sampling water in the Emscher River prior to its discharge into the Rhine River. The purpose of the sampling routine is to determine the source of any toxic wastes that may affect biological life in the Rhine.

River water is pumped continuously into a primary-distribution tank (Figs. 1 and 2). Instruments are provided for recording the pH, the turbidity, and the dissolved oxygen characteristics of this water.

From the primary distribution tank, the water flows to two secondary tanks, which contain fresh tap water. These two tanks are fish aquariums and serve to check the toxicity of the Emscher water. Since the concentration of Emscher River water in these tanks is at least 10 times as great as the dilution ratio in the Rhine, the presence of toxic wastes and their effect on fish can be discovered quickly and their source can be investigated.

Grit Removal and Sedimentation

The Emscher and the Ruhr Districts have developed vertical-flow grit chambers, which maintain uniform upward velocities irrespective of the rate of flow. The grit settles in the bottom of the chamber and is removed by an air lift. In some plants provision is made to divert the lower portion of the sewage flow, where most of the grit is carried, and discharge it to a pit.

In the design of settling tanks, the principal aim is to keep the sewage in a fresh condition. Therefore, the detention period is comparatively short, and raw sludge is removed continuously by mechanically operated scrapers. Circular sludge scrapers are preferred at large plants, using tanks 80 feet and more in diameter.

In the Ruhr District, settling units designed to treat five times the dry weather flow have a theoretical detention period of 45 minutes. These units eliminate the use of storm-water tanks that would normally stand empty most of the time. In some instances where sewage is given biological treatment, a part of the excess storm flow is settled in primary tanks and another part in secondary tanks.

German engineers recognize the importance of knowing the actual detention period available in settling tanks of different designs. The addition of coloring materials or salts to study detention periods is open to various objections. Radioactive isotopes, such as Na^{24} and Br^{82}, have proved their worth in making these studies.

In order to improve the efficiency of settling tanks, considerable study has been given to the design of tank inlets. It is important to eliminate the kinetic energy of the influent sewage and to reduce eddying. At the Wiesbaden plant (Fig. 3) incoming sewage enters the circular tank through a number of downward inclined pipes which radiate outward from the central inlet chamber. Fitted horizontally to the end of each of the pipes is a tee; and between the ends of adjacent tees there is placed a vertical baffle plate. The sewage discharges from the tees, impinges on the baffle plates and flows radially outward from the center of the tank. The same principle of design is used at the Stuttgart-Möhringen plant, except that (instead of baffle plates) segments of spheres are located in front of the ends of the tees.

In the Emscher District plant, two concentric slotted cylinders are provided in the center of settling tanks to reduce the kinetic energy of the influent sewage. Tests

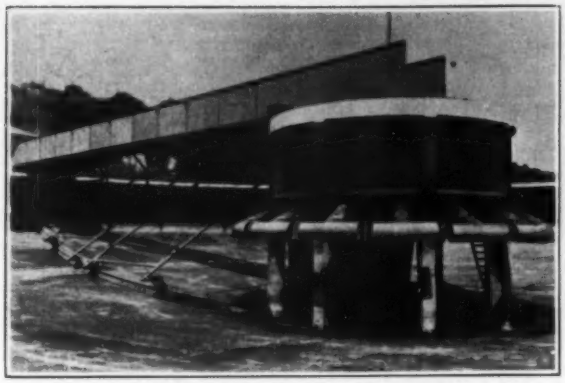


Fig. 3—SETTLING tank at Wiesbaden. Influent flow discharges through T-shaped inlet pipes.

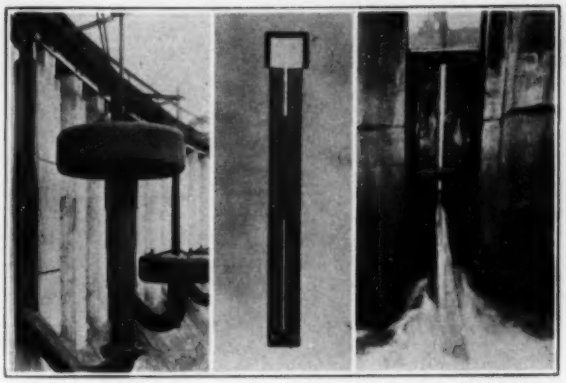


Fig. 4—SETTLING tank at Emscher District plant, illustrating operation of vertical effluent slots.

of detention efficiency were made by using dyes. These indicated that traces of color appeared in the tank effluent within 10 per cent of the theoretical detention period when no slotted cylinders were used; within 28 per cent when one slotted cylinder was used; and within 53 per cent when two slotted cylinders were used.

Efforts have been made to improve the performance of settling tanks by providing multiple effluent overflow weirs (at Hagen and Arnsberg in the Ruhr District) and by the use of vertical effluent slots (at Duisburg-Schwelgern in the Emscher District). One type of vertical effluent slot is illustrated in Fig. 4.

Trickling Filter Data

There has been a marked revival of interest in trickling filters since high-rate filters were introduced nearly twenty years ago. High-rate filters generally are circular, and have an area about one-fifth that of low-rate filters. In designing high-rate filters, a liquid load of 39.6 gal. per capita per day or a B.O.D. load of 0.077 lb. per capita per day frequently is assumed. The design of the underdrain system of trickling filters must be such that: (1) the effluent with its entrained solids will leave the filter quickly, and (2) ample ventilation will be provided. Drainage troughs frequently are provided which have spacings of 15-in. The ratio of openings in the floor tiles and walls, provided to aerate the filter surface, should be approximately in the ratio of 1 to 100. The filter medium should be 1.5 to 2.5-in. or finer in size, and should be supported on a 20-in. layer of material 2.5 to 3.5-in. in size.

If it is necessary to cover a filter to reduce odor and fly nuisances, a forced-draft fan should be provided in the roof. The fan should have a capacity equivalent to 30 times the volume of sewage treated and should operate against a pressure of 0.5-in. of water. The fan should force air downward through the filter media. Table 1 gives the loading and the performance of the high-rate trickling filters at Hagen and Arnsberg in the Ruhr District. The B.O.D. loading at Hagen varied from 1.51 to 2.19 lb. per cu.yd. per day, and the removal varied from 74.0 to 86.7 per cent. At Arnsberg the B.O.D. loading was 0.96 lb. per cu.yd. per day and the removal was 82.0 per cent.

Table 1

HIGH-RATE TRICKLING FILTER PLANT PERFORMANCE
HAGEN AND ARNSBERG, RUHR DISTRICT, GERMANY

City	Date	Filter Depth ft.	B.O.D. of filter influent p.p.m.	Filter Volume Gal.	B.O.D. Loading lb./yd. per day	B.O.D. removal %
Hagen	Sept. 20, 1951		129	5,760	1.63	86.7
	Dec. 6, 1951	10.33	133	5,030	1.51	78.2
	June 17, 1952					
Arnsberg	Sept. 26, 1950	13	71	7,080	0.96	82.0

Activated Sludge Plants

Since the introduction of high-rate trickling filters, only a few activated sludge plants have been built in Germany. One of these is at Neersen where the original plant, built in 1937-38, has been enlarged by the addition of seven aeration tanks having a capacity of 2.39 mg. The tanks are equipped with submerged paddles, have a detention period of nearly 2 hours, and treat a dry-weather flow of 31.8 mgd.

The tanks are designed to reduce foaming. On the dividing wall between adjacent tanks (Fig. 5) an inlet

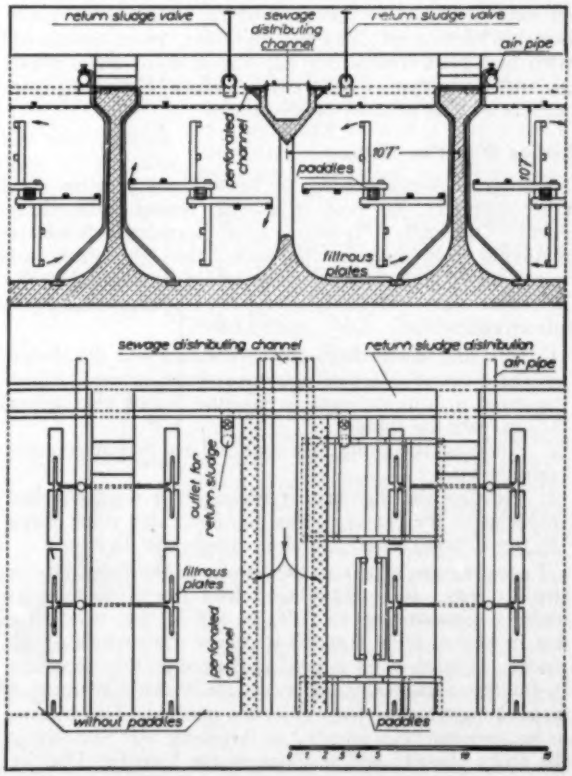


Fig. 5—NEERSEN activated sludge sewage treatment plant in the Niers District.

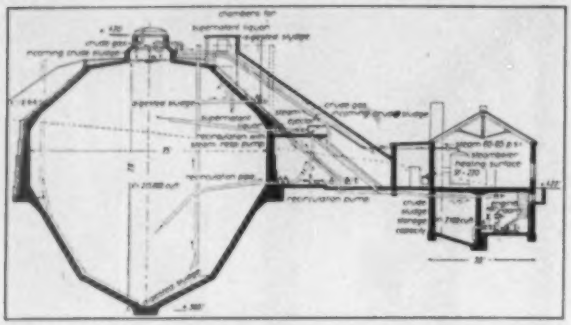


Fig. 6—DIGESTER in Wuppertal-Buchenhofen plant, heated by high-pressure steam.

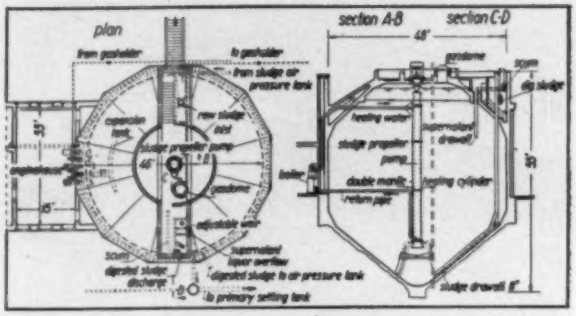


Fig. 7—DIGESTER in Kettwig treatment works, heated by double-mantle heating cylinder.

sewage channel has been built; this extends for three-quarters of the length of the tanks. The sides of each channel are provided with notched weirs, over which the influent flows into two adjacent lateral channels. From these channels, the sewage runs through perforations (located in the channel bottom) and discharges in the form of jets onto the surface of the mixed liquor in the aeration tanks. Any foam produced by the spiral motion of the sewage as it flows under the perforated channels is broken up by the jet discharge.

The Wupper District is constructing at the Central sewage works a high-rate activated sludge plant, to be designed in accordance with United States experience and practice. The Ruhr District will begin building a large activated sludge pilot plant to study step aeration as developed by Gould at the New York City plants.

Land Treatment

Although land treatment of sewage is still being discussed, the value of this method of treatment is questionable because of: (1) the high cost, when compared with biological treatment; (2) the need of large areas of land, in the case of large cities; and (3) the unhygienic aspects of this method of treatment.

Sludge Digestion Plants

Sludge digestion, either in Imhoff tanks or in separate digesters, has been in use in Germany for many years. Originally, digesters were heated by fixed or revolving pipe coils in the tanks, through which hot water was circulated at a temperature of about 140°F. In recent years, several other types of heating have been introduced:

1. Injecting low or high-pressure steam into the sludge in the digester. If high-pressure steam is used, it can be made to pass through an injector, which also serves to circulate the sludge.
2. Pumping the sludge through a heat exchanger outside the tank.
3. Heating the digester by means of a double-walled cylinder in the center of the digester. Hot water flows to the cylinder from a boiler outside the digester.

Low-pressure steam is used to heat digesters only at small plants. It is introduced into the digester units under a pressure up to 7.35 lb. per sq. in., through a nozzle located from 6 to 10 ft. below the surface of the sludge. If hard water is used in the boiler, it is necessary to condition the water—a procedure which constitutes a disadvantage to the steam injection method. This method of heating has been adopted at Arnsberg and Sundern in the Ruhr District and at Unna in the Emscher District.

High-pressure steam at a pressure of 59 to 118 lb. per sq.in. is used to heat large digesters. An interesting example of this method of heating is at the Wuppertal-Buchenhofen works in the Wupper District. The digester (Fig. 6) is 75 ft. in diameter, 77 ft. deep, and has a capacity of 215,000 cu.ft. The quantity of raw sludge handled is 77,500 gal. per day, or 0.125 lb. of organic matter per cu.ft. per day. By means of an injector, steam under an average pressure of 73.5 lb. per sq.in. is introduced into the sludge circulating pipe. A reserve pump is used for circulating sludge if the heating system is not in use or if the ejector is clogged. This method of heating is most advantageous where waste steam from a power plant or an industrial plant is available. Again, a disadvantage applies to this method if the water is hard and requires conditioning.

Heat exchangers located outside of digesters, generally similar in design to those in service in the United States, also are used at the larger plants in Germany, such as in Wiesbaden, Hagen (Fig. 8), and elsewhere. These heat exchangers are either the hot-water bath type or the counter-current tubular heat exchanger type; the latter type, in which hot water and sludge are pumped, is more efficient. The pipes through which the sludge is pumped should be at least 5-in. in diameter, and should have their ends connected by return bends which can be removed to facilitate cleaning the inside of the tubes. Each return bend is provided with a special rubber gasket and is held in place by two bolts. Sludge is pumped through the tubes at a velocity of about 3¼ ft. per sec. against a friction head of 13 to 20 ft. Hot water is maintained at a temperature of about 140°F. The heat transfer through the tubes is about 52 B.t.u./ft²/hr./°F. Proposals have been made to use low pressure steam for heating, and thus to reduce the size of heat exchangers by one-sixth.

Double-mantle fixed steel cylinders installed within digesters are used for sludge heating purposes. The heater consists of two concentric steel cylinders having an annular space of about 2 in. between them, through which the hot water circulates. The cylinder is erected in a vertical position with the upper and lower ends open, to permit the circulation of sludge upward through the inner cylinder. At Ketwig (Fig. 7) in the Ruhr District a propeller pump is provided in the top of the heater, which thus serves to heat the digester and also to provide a draft tube for the circulation of the sludge.

One disadvantage of this type of equipment is that the heating surfaces become incrusted with scale and cannot be readily cleaned. Such being the case, heating surfaces should be designed with an initially high heat transfer of 61.7 B.t.u./ft²/hr/°F., as this may eventually fall to 10.3 B.t.u.

At Göttingen, in the Ruhr District, a double-mantle heating cylinder is used. The cylinder is 33 ft. long, 9 ft.

in diameter, weighs 13 tons, and has a heating surface of 1,780 sq.ft. This heater is used inside a digester having a capacity of 106,000 cu.ft. The ultimate volume of raw sludge pumped into the digester is estimated to be 29,300 gal. per day. The maximum heat requirements to maintain a temperature of 86°F. are as follows:

	Mil. B.t.u. per day
Heating 29,300 gal./day of incoming sludge	15.36
Radiation losses	6.00
External conduit losses	1.04
Total required	22.40

The heat transfer through the walls of the heat exchanger are calculated to be 9.7 B.t.u./ft²/hr./°F.

The maximum heat losses from digesters are in general as follows:

	B.t.u./ft²/24 hr.
Single-stage digesters:	
Well insulated	34
Average conditions	45
Two stage digesters:	
Only first-stage heated	56

Provision for scum control in digesters is essential. At some recently built plants, outlet pipes 10 to 12 in. in diameter have been provided, and are located with their inlets just below the surface of the sludge. At larger plants, propeller pumps have proved of advantage. At small and medium-sized plants, raw sludge pumps installed near the digester are used to stir and circulate the sludge. Variable-speed motors may be used to increase or decrease the rate of pumpage.

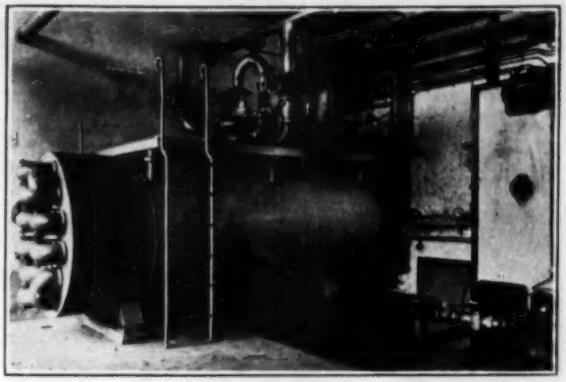


Fig. 8—HEAT EXCHANGER, hot water type. This is in the Hagen sewage treatment plant, Ruhr District.

Sludge Disposal

As elsewhere, the ultimate disposal of sludge is a pressing problem in Germany. It is possible that sludge incineration methods will be given consideration in the not too distant future. Since 1950, a mixture of vacuum-filter cake and air-dried sludge has been dewatered to a moisture content of 30-35 per cent in a coal-fired drum dryer at the sewage treatment works in the Neersen District. The dried material, which totals about 10,000 cu. yd. a year, is screened, ground, and sold as a fertilizer.

Campaign by Sportsmen To Halt Pollution

Some 50,000 sportsmen in the Pittsburgh area of Pennsylvania have joined a campaign to force the state to halt pollution of the Allegheny and Kiskiminetas Rivers.

The sportsmen have expressed their views in petitions sent to the governor, Democratic and Republican leaders and the secretary of the state health department.

The pollution, the petition declares, "is a menace to the health of communities abutting on the streams" and has "destroyed" their recreational values.

Pointing out that industries and municipalities have the financial ability to install treatment equipment, the sportsmen asked state officials to "explain" why existing laws are not being "enforced."

Series of Accidents Marks Bayonne Sewage Project

Until our readers report otherwise, we believe Bayonne, N.J., must hold the record for the most accident-prone sewage project. The press has reported the following series of incidents:

The city went to court to evade constructing the $10 million sewer and sewage disposal system but lost the case; since work was started in November, 1952, the job has caused one headache after another. On the day that starting ceremonies were conducted, three court suits were under way—and only recently the State Supreme Court refused to consider an appeal.

First serious accident was in March, 1953, when a four year old boy was drowned in 18 feet of water in an unguarded excavation pit. Then several workmen were injured in a series of construction accidents.

Now I know what that song means when it says—"They're always blowing bubbles."

In September, a workman was killed by an explosion and fire in a 25-foot deep pit. Work was not resumed at that location, according to our latest report, because police and fire department investigators found the atmosphere to be explosive.

In October, something went wrong in a dynamite blast in a deep trench. Rock and stone, that ordinarily would have been contained by heavy steel mats, became flying missiles: six nearby homes and ten automobiles were damaged as a result. This is the last report we have to date.

Middlesex, N.J., Sewerage Authority Appoints Secretary-Treasurer

The Middlesex County, New Jersey, Sewerage Authority, planning a multi-million dollar trunk sewer, has appointed its first full time secretary-treasurer. He is Edward Dunlap, New Brunswick assistant city engineer. He succeeds William Baumer, Johnson & Johnson official who has served as acting secretary of the authority on a volunteer basis.

During 1953, contracts were completed with the 21 participants in the trunk sewer. These include 14 municipalities and seven industries in Middlesex, Somerset and Union counties. Engineering designs for the estimated $23,000,000 projects are expected to be completed in a year.

N.Y.S.&I.W.A. Holds 26th Annual Meeting

Municipal and industrial waste developments are featured

Retiring President
Harry A. Faber
Assoc. Editor
Water & Sewage Works
New York, N. Y.

Incoming President
W. L. Edwards
Plant Operator
Gowanda St. Hosp.
Gowanda, N. Y.

New Officers

President
William L. Edwards
State Hospital, Gowanda, N.Y.

Vice-President
Clifford E. Irving
Schenectady, N.Y.

Executive Secretary
R. C. Sweeny
White Plains, N.Y.

Treasurer
J. C. Brigham
Albany, N.Y.

New Exec. Comm. Members
James M. Brown, Jr.
Pearl River, N.Y.

Carl J. Bernhardt
Buffalo, N.Y.

Advisory Member
Harry A. Faber
New York, N.Y.

Representative F.S. & I.W.A.
William H. Larkin
Albany, N.Y.

New Vice-Pres.
C. E. Irving
Superintendent
Bur. Sewage Tr.
Schenectady, N. Y.

Program Chmn.
K. S. Watson
Chem. Engr.
General Electric Co.
Schenectady, N. Y.

Exec. Secretary
R. C. Sweeny
Dist. San. Engr.
St. Health Dept.
White Plains, N. Y.

Treasurer
J. C. Brigham, Sr.
Sanitary Engr.
St. Health Dept.
Albany, N. Y.

BOTH municipal and industrial waste treatment problems were well represented on the program of the New York Sewage and Industrial Wastes Assn. at its 26th Annual Meeting in New York City, January 21 and 22, 1954. The registration of 336 members and guests (an increase of 38 over the attendance at the preceding annual meeting) indicates growing interest in the field.

In its business session the Association elected new officers for the coming year. Program Chairman J. M. Brown, Jr., was commended for his excellent and important contributions during two years of service; his resignation was accepted and Kenneth S. Watson was appointed to head the program committee.

The Spring Meeting of the Association will be held at Syracuse, N.Y., June 14-15, 1954.

Award Presentations

President H. A. Faber presided at the Association luncheon. Dr. A. J. Fischer, Awards Committee Chairman, reported favorable increase in the quality and number of published papers referred to the committee during 1953. He presented the Association's three awards:

To FREDERICK NUSSBERGER the *Kenneth Allen Award* for his research paper entitled "Application of Oxidation-Reduction Potentials to the Control of Sewage Treatment Processes." The paper was published in the Federation Journal, September, 1953.

To WM. J. BALL the *Lewis Carpenter Award* for his paper on plant operation entitled "Operation of Inadequate Facilities at Ballston Spa, N.Y." (Published in the *Journal*, December, 1953).

To J. A. SALVATO, JR., the *Charles Agar Award* for his public relations-type paper "Fringe and Rural Area Sanitation."

Mr. Faber introduced William L. Edwards, newly elected president of the Association, and Mr. Edwards then presented retiring president Faber with the past-president's scroll and key in recognition of a job well done.

Sanitation Needs Abroad

Guest speaker at the luncheon was HOWARD L. BROOKS, of the American Korean Foundation, who described the need for recognition of problems existing in Southeast Asia, particularly India and Indonesia. His comments were based on observations made during a visit early in 1953 under auspices of the World Health Organization. The people of these countries live in the past and are not eager to make cultural and economic adjustments except by their own methods, he reported.

Among the common problems observed by Mr. Brooks were ignorance, poverty, sickness and over-population. The sanitation problem is being considered unrealistically and little progress is being realized. The greatest need, he indicated, is for well-trained people at all technical levels, and our responsibility is to provide such assistance as free as possible of politics.

W. H. WISLEY, Exec.-Secy., Federation of Sewage and Industrial Wastes Associations, extended greetings to the New York Sewage and Industrial Wastes Association from the official Federation family. Mr. Wisley presented the 1953 *A. S. Bedell Award* of the New York Association to DR. A. J. FISCHER, Research and Development Dept., Dorr Co., Stamford, Conn., noting that the award recognized Dr. Fischer's service to the Association as a member and chairman of the Awards Committee, and his long period of faithful service to the Association.

A SOCIAL HOUR, held at the conclusion of the first day's program has become a popular feature of the Association's annual meeting; it is sponsored by the Water and Sewage Works Manufacturer's Assn.

Technical Sessions*

"FLOW MEASUREMENTS IN SEWAGE WORKS," was the title of a paper prepared by W. H. BROWN, Project Engr., Builders - Providence, Inc., Providence, R.I. and G. E. SYMONS, PH.D., Consultant and Technical Editor, Larchmont, N.Y.

The paper was presented by Mr. Brown, who described the operating principles of weirs, Parshall flumes, flow nozzles, venturi tubes and orifices. A brief discussion of recording devices, their operating principles and factors to be considered in selecting them was also included. Slides were used to illustrate the several flow measuring devices and the best points of application for them.

Dr. Symons discussed briefly some operating and maintenance problems in connection with flow measuring equipment. It was pointed out that time limitations prevented full discussion of the subject.

Industrial Waste Treatment

"LIQUID WASTE TREATMENT AT ORANGEBURG MANUFACTURING COMPANY" was described in a paper by WM. E. STANLEY, Professor of Sanitary Engineering, MIT, and ROBERT D. ELLIS, Process Engr., Orangeburg Mfg. Co., Inc., Orangeburg, N.Y.

Treatment of liquid wastes at the Orangeburg plant began in July, 1953, following three years of study to select the type of treatment best suited for wastes from bituminous pipe manufacture. The treatment plant was included as an integral part of an expansion program at the pipe manufacturing plant.

Facilities for treating liquid wastes at the Orangeburg Company include mechanical flocculation and sedimentation as normal treatment processes, with or without the addition of chemical coagulants. A measuring weir is located at the sedimentation tank outlet, together with an integrating recorder interconnected with the chemical feeders. Sludge is dewatered and allowed to accumulate in low areas near the treatment plant.

The plant averages 400,000 gal. per day of liquid wastes from which the chemicals (lime and alum) assist in removing 40 per cent of the 5-day B.O.D., 59 per cent of the total solids and 100 per cent of the settleable solids. Chemicals are fed only when flow conditions of the receiving streams require the highest level of treatment to maintain established standards.

Slides were used to illustrate the general plant layout, flow diagram and plant construction.

Bedell Award
Dr. A. J. Fischer
Development Engr.
The Dorr Co.
Stamford, Conn.

Kenneth Allen Award
F. E. Nussberger
Chemist
N. Y. Pub. Wks. Dept.
College Point, N. Y.

Carpenter Award
William J. Ball
Superintendent
Water & Sewage Dept.
Ballston Spa, N. Y.

Charles Agar Award
J. A. Salvato, Jr.
Sanitary Engr.
Erie Cty. Health Dept.
Buffalo, N. Y.

Exec. Comm. Member
J. M. Brown, Jr.
Sanitary Engr.
Lederle Lab.
Pearl River, N. Y.

Exec. Comm. Member
C. J. Bernhardt
Regional Dir.
St. Health Dept.
Buffalo, N. Y.

Federation Secretary
W. H. Wisely
Exec. Secy-Editor
F. of S. & I.W.A.
Champaign, Ill.

Federation Board
W. H. Larkin
Chief, Poll. Control
State Health Dept.
Albany, N. Y.

Pollution Control Program

PROGRESS REPORT—NEW YORK STATE WATER POLLUTION CONTROL PROGRAM" was presented by A. F. DAPPERT, Exec. Secy., N.Y. State Water Pollution Control Board, Albany, N.Y.

Pollution control has progressed since new legislation in 1949 provided improved control machinery, but much work remains to be accomplished.

Legislation enacted in 1949 was designed primarily to prevention of new pollution and to abate existing conditions. New plants must include plans and specifications for waste treatment facilities approved by the Water Pollution Control Board, or the law is violated.

Mr. Dappert revealed that more than 800 plans were reviewed in 1953, compared with 627 in 1952 and 624 in 1951. The Control Board desires to avoid legal enforcement and the issuance of abatement orders wherever possible, but some contributors of pollution "wait out" court orders before proceeding with treatment plants.

Time is required to follow the steps outlined by the New York law which requires the Control Board to classify the surface waters of the state and to prepare and publish a report. Standards must be established within the several classes and public hearings must be held to allow open discussion of the proposed classification before adoption and filing with the Secretary of State. A comprehensive plan for abatement of river basin pollution must then be developed and a cooperative phase between the Board and polluting agencies occurs. Breakdown of the cooperative phase dictates that the Control Board must refer the case to the Attorney General for enforcement.

Mr. Dappert reported that, at present, twenty-three drainage basins have been surveyed and reports completed, with ten river basins officially classified.

Electroplating Wastes

"DISPOSAL OF ELECTROPLATING WASTES BY ONEIDA, LTD." was described by JOHN MADDEN, Oneida, Ltd., for the authors, C. A. Walker, et al. Dr. Walker is Assoc. Prof. of Chemical Engineering, Yale University, New Haven, Conn.

Wastes at Oneida, Ltd. result from the manufacturing of silverware and include acids, alkalies and silver cyanide. In 1941 all wastes flowed untreated into Sconondoa Creek. Lagoons were built to contain the wastes and to allow partial disposal

*The technical sessions were reported by V. W. Langworthy, Research Chemist, The Chlorine Institute, Inc., New York, N.Y.

Industrial Waste Control

Hayse H. Black
Chief, Indus. Wastes
U.S.P.H.S.
Cincinnati, Ohio

Earl Devendorf
Asst. Dir.
St. Health Dept.
Albany, N. Y.

Industrial Pollution Problems

Lyman Cox
Ind. Engr.
E. I. du Pont & Co.
Wilmington, Del.

L. L. Hedgepeth
Tech. Cons.
Amer. Cyanamid Co.
Bound Brook, N. J.

by seepage and evaporation. As lagoon area became exhausted and it was realized that segregation of wastes would be beneficial, studies were made which indicated that only about 25 per cent of the wastes actually needed treatment.

Eighteen months of chemical analysis preceded the construction of a pilot plant to treat 40,000 gpd of acid and 160,000 gpd of alkaline wastes. Wastes containing silver cyanide totalled 5,000 gpd, and contained 3,940 ppm cyanide. The plant uses the batch principle to oxidize silver cyanide at pH 8.0-8.5 by means of sodium hypochlorite. Continuous blending of the acid and alkaline wastes is followed by skimming for grease removal. Lime is added to adjust pH to 8.5 for efficient grease removal. Liquid effluent is filtered through rapid sand filters and clearwell storage provides a source of backwash water. Sludge is thickened in a circular settling unit prior to dewatering on a vacuum filter.

Slides illustrated the flow diagram, plant views and the color coded instrument panel. Visitors are cordially invited and Mr. Madden indicated the overall design was intended to promote good public relations. The plant has performed satisfactorily in spite of increased toxic wastes flow (from 160,000 gpd to 240,000 gpd) and reduces the cyanide concentration to only 0.1 ppm, at a cost of approximately 15 cents per 1,000 gal.

DR. ROLF ELIASSON, Professor of San. Engrg. MIT, discussed the Oneida, Ltd. waste treatment works, and emphasized the value of applying chemical engineering in instrumentation. Careful study of all factors well in advance of plant construction is necessary to insure that the best plant possible will be provided. Segregation of wastes is an important function of the engineer when calculating waste volumes and treatment units.

Waste Treatment Considerations

"A RATIONAL APPROACH TO INDUSTRIAL WASTE TREATMENT" was the title of remarks presented by L. L. HEDGEPETH, Tech. Consultant, Calco Chem. Div., American Cyanamide Co., Bound Brook, N. J.

Industrial wastes and sewage cannot be considered one and the same thing, according to Mr. Hedgepeth, because sewage treatment is fairly well catalogued while wastes from industry vary in character and many types require special treatment (for many, there is no known treatment). Wastes should be prevented whenever possible, thus eliminating any necessity for treatment. The question should never be *whether* water supplies should be protected from pollution, but only *how* to do it.

Enforcement and regulatory agencies should refrain from dealing with top management to solve stream pollution problems. The procedure is "unrealistic and inaccurate," because the facts are that management recognizes the problems and has accepted stream pollution control as an inseparable part of the industrial requirements. The consultant must have a sound case for presentation to management, using individual judgment and working directly with the problem instead of presenting averages and standard values. Mr. Hedgepeth believes that new tools are needed for the appraisal of industrial waste pollution.

The Federation and Industry

"FEDERATION MEMBERSHIP VALUES TO INDUSTRIAL TECHNOLOGISTS" were discussed by W. H. WISELY, Exec. Secy., F.S. & I.W.A.

It was his contention that the Federation is not in "competition" with the many other professional organizations, government agencies, educational institutions and trade associations that are giving some attention to industrial stream pollution problems. The Federation is in the unique position, however, of being the only medium which brings together all the technical and professional elements concerned for the sole and single aim of solving water pollution problems. Water pollution is the basic interest of the Federation; it is but one of many interests to the other organizations and institutions that are presently active in that area.

The Federation is engaged in joint technical activities with several professional societies; it has always cooperated freely with the educational institutions which stage periodic industrial waste conferences; and it has openly urged trade associations to give more emphasis to research in problems of wastes control, treatment, and disposal. There is leadership and guidance in the combined effort.

Flow Measurement

Walter H. Brown, Jr.
Sales Engr.
Builders—Providence
Providence, R. I.

Waste Treatment

Wm. E. Stanley
Prof. Civil & San. Eng.
Mass. Inst. of Tech.
Cambridge, Mass.

Pollution Control

A. F. Dappert
Exec. Secy. Poll. Cont.
St. Health Dept.
Albany, N. Y.

Plating Waste

John Madden
Wastes Engr.
Oneida, Ltd.
Oneida, N. Y.

International Wastes

"INDUSTRIAL WASTES ALONG THE NIAGARA FRONTIER — AND THEIR EFFECT ON THE INTERNATIONAL BOUNDARY WATERS" was the title of a comprehensive paper by H. H. BLACK, San. Engr., U.S. Public Health Service, Cincinnati, O. and EARL DEVENDORF, Dir. Bureau of Environmental Sanitation, Dept. of Health, Albany, N.Y.

Mr. Black presented the paper which reviewed the history of power and industrial development along the Frontier and noted the establishment of the International Joint Commission in 1909. The Commission serves to control industrial waters in the international area. Domestic water requirements are of first importance in the Niagara vicinity, ranking above

industrial process and cooling water utilization.

Pollution originates from domestic sewage, industrial wastes, vessels and combined sewer overflows into rivers and tributaries. Industries have generally proceeded independently to solve pollution problems, and phenols, cyanides and suspended solids have been markedly reduced since 1949. Slides illustrated the geography of the boundary area, points of specific phenol pollution and treatment plants which remove phenols, cyanides, oil and suspended solids.

A. F. DAPPERT discussed the paper, pointing out that an engineer has been assigned to the Frontier by the New York State Water Pollution Control Board. Surface waters are being classified according to the schedule and procedures of the Board, but resistance is being met in establishing a classification for the east branch of the Niagara river. The Buffalo river would undergo only slight alteration if the major industries were permitted to return undamaged cooling water to the stream. This procedure would tend to establish a uniform flow and alleviate slugs of pollution during high flow periods.

Sewage Treatment
C. MacCallum
F. R. Harris, Inc.
Port Washington,
L. I., N. Y.

Activated Aeration
A. H. Chasick, Jr.
San. Engr.
Pub. Works Dept.
New York, N. Y.

Discussion by LYMAN COX, E. I. Dupont de Nemours and Co., Buffalo, N.Y., emphasized that the Niagara river is not grossly polluted. Industrial employees and residents in the vicinity report good fishing in many parts of the river. Industry solves some pollution problems by a great amount of process control together with effluent treatment of manufacturing wastes.

Waste Reduction

"INDUSTRIAL WASTE REDUCTION BY MILL IMPROVEMENT" was related by R. N. DRUMMOND, Chief Chemist, Research Div., International Paper Co., Glens Falls, N. Y.

Surveys preceded in-plant conservation measures in order to determine the volume and character of all

Waste Reduction
R. N. Drummond
Chief Chem., Res.
International Paper Co.
Glens Falls, N. Y.

Oil Wastes
W. H. Lang
Wastes Superv.
Standard Oil Devel. Co.
Linden, N. J.

Phenol Recovery
J. C. McCord
Asst. Plant Supt.
Bethlehem Steel Co.
Lackawanna, N. Y.

Sewer Standards
C. C. Spencer
Dir., Envir. San. Div.
Erie Cty. Health Dept.
Buffalo, N. Y.

wastes. "Save-alls" reclaim white water for re-use in paper machines and approximately 4,000 tons of pulp are recovered per year.

Alkali recovery is essential to efficient caustic soda pulp production with concentration by evaporation eliminating 16,000 tons of alkali per day as a stream pollutant. Calcium carbonate sludge has been removed as a source of pollution by a recalcining installation which reclaims 900 tons of lime annually.

Treating Oil Waste

"OIL REFINERY WASTE TREATMENT" was the title of a paper presented by Dr. W. H. LANG, Standard Oil Development Co., Linden, N.J.

Segregation of waste waters at a refinery is mandatory due to difficulties encountered in solids removal when solids became coated with oil. A typical refinery separates waste water into three groups: Dirty water which contains oil, clean water containing little oil, and by-pass water which never is contaminated with oil. Dirty and clean waters are treated separately in oil removal units of standard API design, while by-pass water receives no treatment.

Refinery wastes also include spent acids, spent caustics and phenol-bearing water. Acid wastes are used to dilute stronger acids and caustic is recovered and sold. Phenolic wastes are treated by means of biological filtration.

Disposal of sanitary sewage by arrangement with local municipality is preferable, but this firm will treat the sewage at the refinery if necessary. All types of conventional sewage treatment processes are utilized, depending on location and degree of treatment required.

Dr. Lang outlined the activities of the Oil Wastes Committee of the Amer. Petroleum Institute in air and water pollution abatement. Sub-committees are active on specific waste problems and in revising the API Manual.

Phenol Recovery

"DESIGN AND OPERATION OF A PHENOL RECOVERY PLANT" was the title of a paper presented by J. C. MCCORD, Asst. Supt., Lackawanna Plant, Bethlehem Steel Co., Lackawanna, N.Y.

Coking operations produce phenolic-type organic compounds containing 1,444 ppm phenol. The wastes are first passed through an absorption tower where a light oil, zenbol, absorbs the phenol. A second tower provides contact between caustic soda and phenolized oil to produce sodium phenolate. Removal of 98 per cent of the total phenol to 17 ppm is attained by this method.

Important factors contributing to efficient operation are: good design which provides intimate liquid contact and close attention to viscosities and densities of the liquids. Slides illustrated flow and plant arrangements.

Municipal Sewage Problems

"SEWAGE TREATMENT AT PORT WASHINGTON" was described by C. MACCALLUM, Consulting Engineer, Port Washington, N.Y.

Domestic sewage, containing no industrial wastes, is treated at a biofiltration plant having primary and secondary sludge digestion facilities. The disposal works are designed to receive sewage from a population of 25,000, plus scavenger wastes from several cesspool cleaning services. Plant effluent is disinfected by chlorine in a 24-in. outfall sewer, which allows a contact time of 25.7 minutes at 6 mgd flow rate. Overall B.O.D. removals are 96 per cent and suspended solids reductions 91.5 per cent.

It was reported that erratic disinfection has occurred when chlorine residuals of 2.0 ppm or less are carried in the plant effluent. Tables prepared by Mr. MacCallum revealed that of 38 analyses recorded, 3 exceeded maximum allowable limits in spite of the presence of 2.0 ppm or more residual chlorine. He indicated

erratic disinfection is being experienced at other trickling filter and activated sludge sewage treatment plants.

V. W. LANGWORTHY reported that the Chlorine Institute, Inc. is investigating reports of erratic disinfection with chlorine and a detailed analysis would be published when sufficient data have been obtained. Plant operators who have experienced similar disinfection inefficiencies with sewage chlorination were encouraged to correspond with the Chlorine Institute.

L. H. ENSLOW, Editor, *Water and Sewage Works,* suggested the possibility of coliform bacteria eluding the effect of chlorine due to solids clumping. He also indicated that present-day laboratory techniques and increased sampling programs could be revealing a previously undiscovered truth.

A New Treatment Process

"ACTIVATED AERATION AT THE WARDS ISLAND PLANT" was the title of a paper by A. H. CHASICK, San. Engr., Dept. of Public Works, New York, N. Y.

The process was described as one which included additional aeration of the return activated sludge for up to 8 hours following normal aeration cycles. Results indicate activated aeration provides greater suspended solids and BOD removal accompanied by less air requirements than the modified suction process. Slides illustrated flow diagrams and how the Ward's Island plant was operated as two separate plants in parallel for the purpose of this study. The need was stressed for circular sludge concentration tanks to effect better sludge thickening.

Sewer Extensions

"RELATIONSHIP OF CURRENT STANDARDS FOR SANITARY SEWERS TO PRESENT COMMUNITY NEEDS" reported a comprehensive study of conditions in Erie county, N. Y. Prepared by C. C. SPENCER, Dir. of Envir. San., Erie County Health Dept., Buffalo, N.Y., the paper discussed difficulties encountered when sewers are extended to real estate developments adjacent to an established municipality.

The basic question of whether such areas should be provided with public sewers or should have private (septic) systems, is difficult to answer. Other problems arise when public sewers are extended, such as the acceptance of roof, floor and footing drains from dwellings. Increasing sanitary sewer sizes to handle flows from these sources is expensive and usually not warranted.

C. J. BERNHARDT, Reg. Dir., P.H. Engry., State Dept. of Health, Buffalo, N.Y., discussed Mr. Spencer's paper, asking what is a sound sanitary sewer system? The answer is: one designed by a capable engineer and approved by the State Health Department. An important factor often overlooked is that the homeowner generally doesn't know what are his responsibilities regarding the sanitary sewer system. This can only be solved by a selling job through good public relations.

Hitzrot (left) succeeds Quigley (right) as Director of Federal Water and Sewerage Industries and Utilities Division

Hitzrot New Director and Quigley Consultant of Federal Water and Sewerage Industry and Utilities Division

On March 9th, Henry W. Hitzrot of Westport, Conn., was appointed director of the Water and Sewerage Industry and Utilities Division, Business and Defense Services Administration, U.S. Dept. of Commerce. The appointment was announced by B.D.S.A. administrator Charles F. Honeywell, and the oath of office was administered by H. B. McCoy, deputy administrator. Mr. Hitzrot, who will serve for six months without compensation, is on loan from the Dorr Co., Stamford, Conn.

He succeeds Thomas J. Quigley of the Wallace & Tiernan Co., Belleville, N.J., who had served for six months as director of the Division and who will continue to act as consultant. Walter L. Picton, deputy director, assists in management of the division.

Mr. Hitzrot received his B.S. degree from Princeton University and an M.S. degree in metallurgy from Harvard Engineering School. He has been associated with The Dorr Co. since 1927. Widely experienced in the water and sewerage field, he was special assistant for engineering sales for that company in 1953.

Wash Water Measurement

(A Correction)

In his article "Wash Water Measurement in Filtration Practice" in our February issue (p 79), Professor Angus wishes to direct attention to mis-lettering of diagrams 3 and 4. In the first (Fig. 3) the letter E should have designated "the pressure water supply inlet" and the letter F should have been used to designate the "outlet or drain port." In similar manner in (Fig. 4) the letter E and C should be interchanged so as to make the text read as it should.

If the interested reader was a bit confused and failed to recognize the fact that the letters E and F in (Fig. 3) and E and C in (Fig. 4) should have been reversed as to position, he should change the lettering accordingly, after which the text will read as was intended.

Wastes to be Topic at Meeting of Consultants

A symposium on "Water-borne and Air-borne Wastes" will be the topic of a dinner meeting of the Association of Consulting Chemists and Chemical Engineers in New York City on April 27, 1954.

The guest speakers will be Harry A. Faber, Assoc. Editor of *Water & Sewage Works* magazine, and William G. Christy, consulting engineer of New York.

Oxidation-Reduction Potential

A review of factors involved in applying this new tool to the operation of sewage treatment processes

by **ROBERT SHAPIRO**, *Chief of Laboratories, Dept. of Public Works, New York, N.Y.*

This article is based on a lecture which Mr. Shapiro presented at a symposium of the 1953 Conference on Instrumentation sponsored by Manhattan College, New York City.

SPURTS of progress in fields of science frequently follow the development of new instruments of research which can reveal, measure the extent, or show the inner nature of the forces with which we are dealing. It would be difficult to conceive of the development of the science of bacteriology without the use of a microscope. The scientist of today strives to wring out the last bit of utility from the instruments at hand and when they can no longer serve him, he reaches a plateau in his progress until he invents, devises or adapts a tool suitable for further investigation.

The use of the potentiometer to measure the varying ratios of oxidized and reduced products in a media in which bacteria are growing is such a tool for the study of biological sewage treatment processes. As long ago as 1911, Potter [1] observed that a broth in which bacteria were growing produced a potential lower than that found in a sterile broth. In 1920, Gillespie [2] reported that electrical potentials between noble metals and bacterial cultures become progressively more negative as if they were developing a more intense reducing environment.

Since that time, numerous workers have experimented with redox * potential measurements in the laboratory and in the field. It appears desirable to review some of the results obtained and to attempt to integrate those results as they apply to the problem of sewage treatment so that future application and experimental work will be most fruitful. It is equally vital to be aware of the limitations and errors which may be inherent in the instruments available for use. Employment of an instrument without an understanding of its limitations makes it a Frankenstein.

Redox Potential

In any redox system, there is an exchange of electrons between the oxidized and reduced components which are present. This is an electrical phenomenon, the intensity of the reaction varying with the ratio of the oxidized and reduced components involved and this is measurable as a voltage. To measure the redox potential therefore, an inert electrode, acting simply as a contact and conductor, is immersed in the system being studied and an opposite external potential is then applied which can be varied in such a manner as to balance the internal voltage. By measuring the externally applied voltage it is possible to determine the potential of the system. Inasmuch as there is no fixed reference point, the "hydrogen" electrode is given the arbitrary value of zero. In practice the hydrogen electrode is seldom used because it is cumbersome, but other standardized electrodes may be used such as the calomel cell for which the data are usually computed back to the hydrogen standard and expressed as E_h. Positive and negative values of E_h, of course, are purely arbitrary and bear no relation to the actual charges carried on the particles of the system, but only express the oxidizing or reducing characteristics as compared with hydrogen.

Bacterial Activities

Bacteria utilize organic material, obtaining energy for metabolism while degrading the by-products to a lower chemical energy level. This result is accomplished by the process of reduction which releases to the media the intermediate reduced products and hydrogen ions. In order to maintain this reaction, it is necessary to have some means of removing the hydrogen ions formed from the sphere of action; i.e., hydrogen acceptors must be available in the immediate zone where the reaction is taking place. The most commonly available hydrogen acceptor is oxygen.

If free oxygen is not present, the hydrogen ion may react with some form of chemically combined oxygen such as found in nitrate or sulphate. This is the mechanism of reduction which takes place under anaerobic conditions. Oxygen obtained from either source has been shown to be reduced in two stages, the first being the formation of hydrogen peroxide, which is reduced further to form water.

Bacterial respiration is dependent upon various enzyme systems. The oxygen in solution is not utilized directly by the bacterium but it must first be "activated" by some compound like the cytochrome in the bacterial cell in order to react with the released hydrogen to form the peroxide. Then by means of peroxidase enzymes the reduced substrate may be oxidized to a more stable form. Many other bacteria are capable of forming another enzyme "catalase" which reacts with peroxide releasing active oxygen and at the same time preventing the dangerous accumulation of toxic concentrations of hydrogen peroxide, converting it to water.

From the above viewpoint, when we measure dissolved oxygen or determine oxygen utilization rates in order to judge bacterial metabolism, we are really measuring a secondary reaction. The primary reaction is the chemical combination of hydrogen ions with activated "oxygen," not with the oxygen in solution. This has been shown to be true by a number of workers in this field.

Experimental Observations

Hewitt[3], and Moore, Ruchhoft and Wattie [4] studied changes in the potential of pure cultures of E. coli in the presence of glucose. They found that there is an initial rapid fall of potential for the first few hours of growth, followed by a restoration of potential at a slower rate than the drop. This drop in potential occurs both under quiescent conditions and when the culture is being vigorously aerated. With aeration, the potential did not fall as far as it did under quiescent conditions. In the same study, Moore, Ruchhoft and Wattie showed similar results for A. aerogenes and perhaps even more to the point, that for a pure Zooglea culture isolated from activated sludge, there is a reduced potential produced followed by a recovery period.

In this pure culture study, they also showed that when nitrogen, instead of air, is bubbled into cultures similar curves were obtained. There

* Oxidation-reduction potential; also called O.R.P.

POLAROGRAPH—a model suitable for quantitative measurements of the oxidation-reduction potential of biological systems

was an initial lag followed by a rapid drop and then (despite the lack of oxygen) a rise in the redox potential. Glucose was utilized at a constant rate during this experiment. In a mixed culture study, using activated sludge, Moore and Ruchhoft[5] found that the potential fell in the usual pattern, but failed to rise after 90 hours of continued agitation with nitrogen, thus showing the role of oxygen in the recovery stage in the activated sludge mixture.

Dickinson[6] grew an activated sludge floc around a platinum electrode and measured the potential against bright platinum electrode in the same medium. He also found an initial drop in potential, then a subsequent rise when sewage was fed and the mixture aerated. It is the rapid utilization of food stuff which coincides with the initial rapid drop in potential as shown by Watanabe[7], who studied the disappearance of pure carbohydrates showing a 95.6 per cent loss of added glucose within eight hours and indicated that aeration increased the rate of disappearance of carbohydrates.

Some of the early work by Clark[8] showed that an active culture of bacteria reduced the media to the equivalent of an oxygen pressure of 10^{-28} atmospheres while bubbling oxygen through it.

Hewitt[9] calls attention to the slight effect of molecular oxygen on the potentials of active cultures and to the avidity of aerobic bacteria for the oxygen in some available form for their metabolic processes. His experiments even show examples of some cultures which are capable of producing a lower potential upon aeration than under quiescent, but aerobic, conditions.

Rohlich[9] showed that a high starting potential in an activated sludge mixture remained at a fairly high level even while the dissolved oxygen is dropping rapidly. Only after the dissolved oxygen falls below 1.0 ppm does the redox potential begin to decline. He could find no point on the potential curve which coincided with oxygen depletion. Similar results were found by Moore and Ruchhoft[5] in activated sludge mixtures.

Why Potential Drops

As the bacterial activity slows down after the logarithmic bacteria growth phase, the highly reduced conditions may be slowly neutralized by utilization of the oxygen which is available and then the potential drifts up again. A divergence from the original potential occurs if there is a difference in rates of activity of the enzyme systems involved or where it is not possible physically to move the reacting materials in and out of the fields of action at a sufficient rate. Even in these days of nonchalant acceptance of huge numbers, the magnitudes of the reactions occuring on the molecular level is astounding. It has been calculated that a single E. coli bacterium, during the logarithmic growth phase, can reduce fifteen million molecules of glucose a minute and from the empirical formula this will require 75 million molecules of O_2 per minute partaking in the reaction.

In sewage there are millions of bacteria per milliliter capable of reducing various organic materials. As indicated previously, Rohlich found the potential to be constant until the dissolved oxygen fell to less than 1.0 ppm. It is simple to compute that 1.0 ppm though seeming to be a very small concentration represents 1.9×10^{19} molecules of oxygen per liter (a number in the quintillions) which is still adequate for the reaction if it can get into the reaction zone. In this regard it might be the low oxygen tension, which reduces the diffusion rate into the sludge particle, thus becoming the significant factor in permitting a drop in the potential when the reaction reaches this concentration of dissolved oxygen.

This explanation appears to be a paradox, since all these experimenters have shown that the rapid development of reducing conditions occurs in the presence of dissolved oxygen or even requires it for the reducing activities of the cells to reach their maximum intensity. Apparently, redox potential is not a primary measure of aerobic conditions, but rather of metabolic activity, so that direct correlation with dissolved oxygen should not be expected.

Theoretical Considerations

In the bacteriological conversion of organic material into stabilized products, we are dealing with two different reactions which are occurring simultaneously. In the first, dissolved molecular oxygen must be "activated" by the bacterial enzymes present before it can take part in the biochemical reactions. In the second, this "activated" oxygen is now available to react with the reduced products which are being formed from normal metabolic processes. In a vigorously growing culture, the conversion of molecular to "activated" oxygen apparently takes place at a slower rate than the formation and neutralization of the reduction products. Therefore, "activation" of oxygen becomes the limiting factor in maintaining an equilibrium.

The slower reaction will be influenced by the enzyme systems of the specific organisms involved and may also be effected by the limitations of diffusion of the molecular oxygen into the inside of the sludge particle or into the immediate zone of reaction. If the oxygen "activation" rate is high then the reduced metabolic

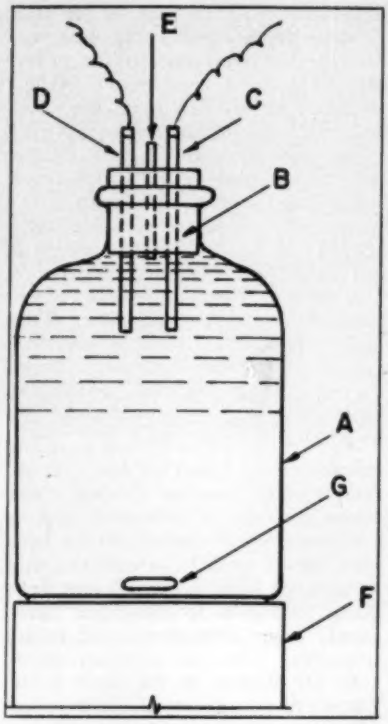
by-products will be rapidly neutralized and the destruction of organic matter can continue at a high rate while the potential will not fall drastically and can recover rapidly. In such a case, the dissolved oxygen can be used up rapidly while the redox potential will not be affected so much.

If, however, the "activation" is not proceeding as rapidly as required (the usual case) then the reduced by-products will at first accumulate causing a drop in oxidation-reduction potential (O.R.P.) even while an excess of dissolved oxygen may be found in the fluid medium around the sludge particles. If a source of molecular oxygen is not available, while the reduced products are accumulating, then the presence of the reduced products form a favorable medium for the action of anaerobic enzymes. This type of organism will take over and the redox potential will remain low.

Sludge Toxicity Factor

It appears that even the mechanical action of air, creating a circulation of food and by-products, becomes important in making possible the rapid biochemical changes which are taking place next to and within the bacterial cell. Under quiescent conditions, such as in a settled sludge, the loss of food and molecular oxygen and the accumulation of intermediate metabolic products adjacent to the cell will slow down the reactions of the initial aerobic organisms until other bacteria capable of utilizing these degradation products take over and reduce the potential still further. At this stage the sludge is regarded as decomposed or degraded. Bacteriological activity requires the removal or neutralization of the by-products of metabolism or the processes become self-limiting. The by-products may be either toxic or so effect the growing media as to make the ingredients no longer assimilable.

It might be deduced from the experimental work quoted that the potential which an organism will produce and the extreme limits of oxidized and reduced environments under which it can continue to be active depends upon the specific enzyme systems which that organism can synthesize. Generalizing, it may be said that aerobes require a moderately oxidizing potential; that anaerobes will grow only when the potential reaches approximately zero or to minus values; and that faculative organisms have a broad range of enzymes which can act through a wide range of potentials. The various organisms have enzyme systems which are capable of catalizing their vital reactions only at specific potential levels much as they require specific pH levels to carry on their activities.



O-R POTENTIAL laboratory set-up to study changes in liquid without admission of air.
A. One-liter wide-mouth bottle
B. Three-hole rubber stopper
C. Calomel cell
D. Platinum electrode
E. Glass tube
F. Magnetic stirring device
G. Magnetic bar

In the laboratory, anaerobes can be grown in a "sloppy" media containing 0.2 per cent agar which limits air diffusion, or by adding ingredients, which will react with dissolved oxygen, such as 0.1 per cent thioglycollic acid. Even the presence of iron will restrict oxygen utilization. There may be an analogous situation in activated sludge which, within the gelatinous matrix of the sludge particle may have high viscosity, reduced organic acids and metals capable of combining with free oxygen. Such conditions would encourage a reducing environment. If there is a physical or chemical block of free diffusion of oxygen, the reduced products accumulate, the potential drops and the active microflora is altered.

Rohlich [9] showed that the potential change in a mixture of organisms depends upon the concentration of sewage which is being fed to the culture. The lower the concentration of organic matter, the more rapid was the increase in the ratio of oxidant to reductant and therefore the more rapid the recovery of a high potential. This could explain some of the advantageous treatment changes which occur in heavily loaded activated sludge plants following a rain storm or if the return sludge ratio is markedly increased thereby recirculating high potential, low solids, final tank liquor. This could be a critical factor in short time aeration tanks where the potential-time curve may not readily be condensed within the aeration time allowed. The potential of the sludge under aerobic conditions is not effected by its concentration but rather by the rate and concentration of the sewage fed to it.

Activated Sludge

The activated sludge process, in use since 1914, has been applied practically and with great benefit and skill despite the limited knowledge of the fundamental processes involved. The refinements of the process, which can be attained by further trial and error or intuitive methods, are becoming more limited just when even small improvements could make a considerable difference in the economics or efficiencies of large scale sewage treatment programs now underway.

In the actual operation of an activated sludge plant we are interested in the rapid removal of organic material as effected by bacterial growth. From the theoretical discussions, it may be expected that if a sufficiently high potential is developed within the aeration tanks after the last addition of food, and if the intermediate reduced bacterial products had been well metabolized, then the changes for unfavorable anaerobic growths will be minimized. For example, many of the enzyme systems of the anaerobes require reduced forms such as sulphydryl groups in the substrate as initiators or activators for their reactions. These reduced SH groups cannot remain reduced in an accessible, strongly oxidizing medium. In a well-oxidized sludge, therefore, the anaerobes cannot begin to proliferate until some faculative organism has produced these required reduced groups. This may provide a margin of time for safely moving the sludge from the settling tanks back to the aeration tanks.

Prolonged holding or frequent intermittent holding of a sludge at either extreme of redox potential could act in a selective manner so that a limited microflora can become predominant. At low potentials, of

course, unfavorable anaerobes may proliferate. At a very high potential, the formation of hydrogen peroxide may be lethal to some organisms and the enzyme systems of others, as has been indicated previously, will not function. This condition would represent a so-called "over-oxidized" or "underloaded" activated sludge and would show up by a dissolution or break-down of the sludge floc with high turbidity formation.

Importance and Limitations of Redox

It appears from the above evidence and the hypotheses presented, that the redox potential measurement should be a key for the understanding and control of the activated sludge process. Certainly, it is indicated to be a more basic entity than dissolved oxygen or short period oxygen utilization tests since these may be only secondary reactions in the metabolic cycle.

Unfortunately these academic considerations have not been directly applicable to field use as yet but tests and experiments are continuing in an attempt to correlate the data obtained with the actual plant conditions. A heterogenous biological mass such as the activated sludge floc is a constantly changing system that is forever in a state of flux. Any equilibrium is a dynamic one existing but for the fleeting moment of the test. Besides the redox potential changing, the chemical composition of the media, the pH and the number and variety of the organisms developing are varying. If artificial means are used to hold some of these factors constant, such as buffering for pH control, the same normal bacterial system is no longer being measured. The change in pH alone will affect the potential readings since it means a change in hydrogen ions and it also affects the ionization of other materials. This factor cannot readily be corrected for in O.R.P. readings because the curve relating E_h to pH has a varying slope.[10,11]

One further limiting point in redox measurements lies in the fact that intensity of the reaction is being noted when potential is measured with a null-point potentiometer. Redox systems have a capacity as well, and this is referred to as "poised," this term being analagous to the word "buffered" when considering pH measurements. The data obtained therefore are limited in the same sense that we do not express alkalinity when pH is measured, nor do we measure total heat when temperature is determined.

Perhaps with the use of the polarograph instead of a potentiometer, experimental data would be more informative since this instrument could supply figures of the concentration of the redox potential system.

The measurements of redox potential to be used as an indicator or guide for the operation of the activated sludge process is a very appealing one from a theoretical viewpoint. There are some unsolved problems, and some obscure correlations involved. It is the author's belief that these can be resolved and that they do not present insuperable obstacles to progress as long as we carefully remain aware of the limitations of O.R.P. instruments and of what they are truly measuring.

References

1. Potter, M.C., Proceeding Royal Society of Britain *84*: 260 (from Hewitt)
2. Gillespie, L. J., Soil Science *9*: 199 (1920)
3. Hewitt, L. F., "Oxidation-Reduction Potentials in Bacteriology and Biochemistry" E. & S. Livingstone Ltd., Edinburgh.
4. Moore, W. A., Ruchhoft, C. C., and Wattie, E., Sew. Wks. Jour. *14*: 980 Sept., 1942.
5. Moore, W. A. and Ruchhoft, C. C., Sew. Wks. Jour., *15*: 880 Sept. 1943.
6. Dickinson, D., Abst. Sew. Wks. Jour., *13*: 632 May, 1941.
7. Watanabe, M., Abst. Sew. Wks. Jour., *13*: 633 May, 1941.
8. Clark, W. M., "The Newer Knowledge of Bacteriology and Immunology", E. O. Jordan and I. Falk, p. 188.
9. Rohlich, G. A., Sew. Wks. Jour., *16*: 540 May, 1944.
10. Knight, B. C., Biochem. Jour., *24*: 1966, 1930.
11. Clark, W. M., Cohen, B., Pub. H'lth Rep., *38*: 666, 1923.

Ed. Showell Retires: To Conduct Consulting Service

Edward B. Showell, senior consulting engineer on water and industrial wastes for the du Pont Co., has been retired after more than 35 years with the company.

Beginning his career with du Pont in 1915 as superintendent of water at the company's Hopewell, Va., plant, he has had wide experience in the field of water conditioning and purification. In more recent years he has devoted his time increasingly to the problems of pollution abatement. He has served as chairman of the Chesapeake Section of AWWA, and recipient of the Fuller award "for his invaluable contributions in the field of water conditioning, and his inspiration and guidance in the training of young engineers."

One of Mr. Showell's outstanding accomplishments was his work on the design of water facilities for the Hanford Engineer Works, the largest industrial water filtering and conditioning plant in the world. For his work on these facilities, he received a citation from the Federal Government.

Through his water investigations for proposed plant sites, he has become familiar with water sources generally throughout the United States, as well as requirements for stream and atmospheric pollution abatement. He is therefore well qualified to offer consulting services in the field of water supply and stream pollution. He will operate from his home: R.D. #1, Chadds Ford, Pa.

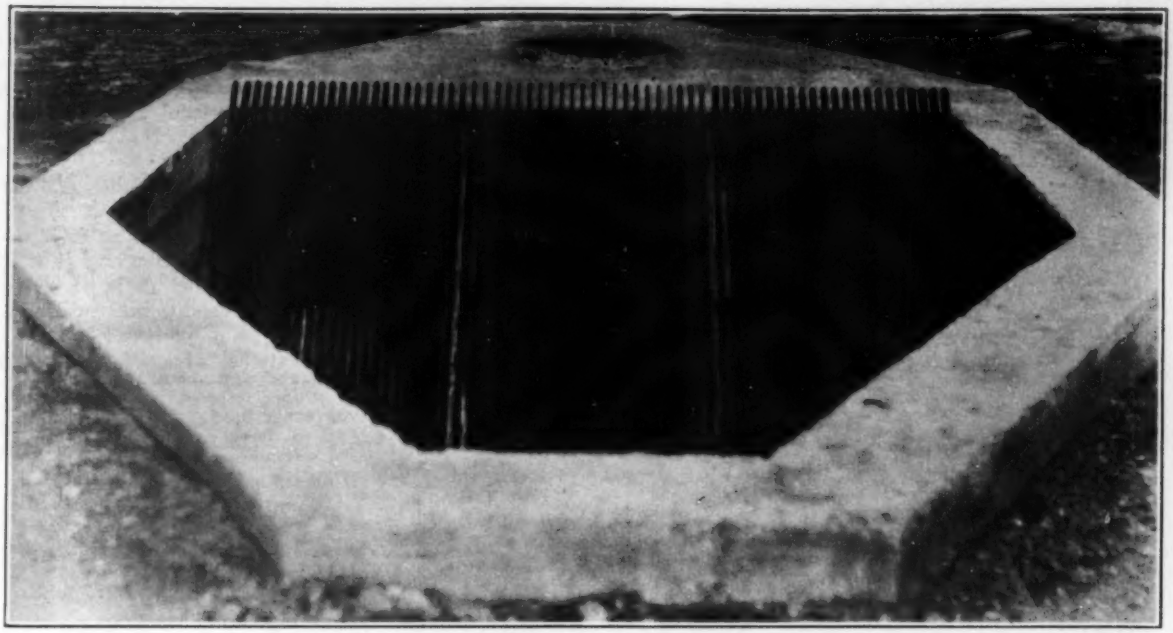
Don't Run Around in Circles

To keep from running around in circles—all you have to do is think straight.

Correction: Florida Fuller Award to Keller

The Florida Section, A.W.W.A., named S. Keith Keller the recipient of its George W. Fuller Award. In our report of the Florida Section meeting, in the February issue, page 65, we incorrectly listed R. Hosey Wick as the award recipient.

Mr. Keller, of Clearwater, is General Superintendent of the Pinellas County Water System, and Mr. Wick is Chairman of the Board of Commissioners of that System. We regret our confusion of these two individuals and extend our apologies to Messrs. Keller and Wick.



CONCRETE box screen chamber housing a sectional bar screen

Sewage Screen Chamber Design

A review of basic factors and design details which determine efficient operation

by **JOSEPH C. FEDERICK,** ***Asst. District Engr., N.Y. State Dept. of Public Works, Syracuse, N. Y.***

RACKS and screens are important units in sewage treatment plants. The function of these units is to remove the floating and some of the suspended matter from incoming sewage. The material removed is termed screenings. It consists principally of rags, leaves, wood, garbage, paper, etc., together with the coarse organic solids. The resulting straining action, as sewage flows through screenings, removes certain parts of the finely divided suspended solids.

The removal of floating and suspended material protects pumps and other mechanical equipment, prevents clogging of pipes, slots and channels, and reduces the quantities of solid materials collected in grit chambers and sedimentation tanks. The removal of coarse organic solids also reduces the organic load on the subsequent treatment processes.

Basic Considerations

Screens are housed in a structure designated as a screen chamber. The structure may be an open uncovered concrete box with flared ends, to serve a single bar screen in a small installation; or it may be an elaborate building housing several mechanically cleaned screens in a large treatment plant.

The effectiveness of the screening process will be determined largely by the adequacy of the design for the screen and the screen chamber. The chief factors which determine the proper proportioning of this structure are: character of the sewage, characteristics of the screen, hydraulic factors, and operation practices.

Solids Content of Sewage

The principal consideration in screen design and operation is data on the amount of solids, particularly organic solids of relatively large dimensions, and the quantity of floating material. Practically all floating material and the larger suspended solids will be retained on the screens. As mats of this material build up on the screens, a straining action takes place which removes a portion of the finer solids from the sewage. Certain industrial wastes contribute large quantities of solids to sewage. Likewise, the increasing practice of disposing of garbage in municipal sewers after grinding increases the solid content of both combined and sanitary sewage. The quantity of sewage and the variation in the rate of flow are also factors of prime importance.

Screen and Hydraulic Factors

The type of screen to be used is determined by the character of sewage, the volume to be screened, and the amount of material to be removed. The capacity of the screen is a function of the size of opening, the area submerged, the velocity of flow through the screen and the approach and exit channels, the angle of setting, the permissible loss of head through the screen, and the method and frequency of cleaning.

Influent and effluent channels

should be designed to produce a uniform distribution of flow at a velocity which will prevent deposition of material in the channel, but at a velocity which will not force screenings through the openings of the screen. The latter velocity is that perpendicular to the screen, and consequently is affected by the angle at which the screen is set.

The permissible loss of head through the screen is fixed by particular conditions at any given plant. The permissible loss of head is the chief factor determining the method and frequency of cleaning.

Irrespective of flow or character of the sewage, the total set area of the screen should be not less than 5 square feet. The width of the channels must be sufficient to permit raking without difficulty. Minimum widths of 18 inches and 2 to 3 feet are required for raking hand and mechanically cleaned screens respectively.

Installation Details

Screens may be installed singly or in duplicate. Where there is only one screen and one screen channel, a by-pass should be provided to prevent flooding of the screen chamber and to allow for its dewatering.

Screen chambers should not be located in deep pits unless it is unavoidable. Enclosed screen chambers should be of adequate size, well lighted and ventilated. In the case of hand raked screens, it is essential to allow sufficient room for the operator to move freely, and to facilitate the making of repairs. A convenient means of removing filled containers of screenings also is a requisite.

Official Requirements

The rules and regulations of the Pacific Northwest Basin Pollution Control Council, the Upper Mississippi River-Great Lakes Boards, and the State Health Departments of New Jersey, Florida, and Texas consider screens desirable at all sewage treatment works. In general, screens are required at the inlet to the plant or ahead of pumping units.

Screens may be of the bar type, coarse or fine mesh type, either stationary or mechanically operated. The clear openings of coarse screens of the fixed bar type are specified to be not less than 1-in. and a maximum of 2-in. The clear openings of mechanically cleaned racks vary from ⅝-in. to 1½-in. The slope of the screens is set between 30° to 45° with the horizontal. When under-water shredding devices are used duplicate units must be installed, or an auxiliary bar screen is required.

The net submerged open area of the screen is designated on the basis of the velocity of sewage flow through the screen. The PNB Council considers a velocity of 2 ft. per sec. satisfactory, whereas the UMR-GL Boards specify 1 ft. per sec. of average flow for hand racked screens and a maximum of 2½ ft. per second for mechanically raked units. New Jersey requires that the minimum velocity in the chamber be 2 ft. per second, with a maximum of 3 ft. per second.

Head Loss Computation

The head loss through coarse bar screens may be computed by either of the following formulas:

$$h_e = \frac{V^2 - v^2}{2g} \times \frac{1}{0.7}$$

$$h_e = \frac{0.5\,V^2}{2g} + \frac{V^2 - v^2}{2g}$$

Where:

h_e = loss of head (clean bar screen)
V = velocity between bars
v = velocity in approach channel

The head differential for intermittent screen operation may be set at 3 to 6 inches.

Illustrative Problem

The numerical example which follows is provided to illustrate the application to screen chamber design of the principles discussed.

Find the required dimensions for a hand raked bar screen and screen chamber having a by-pass under the following conditions:

Average flow of separate sewage is 1.0 mgd

Maximum flow is 2.5 times the average

Screen openings to be one inch clear Bars are ⅜-in. by 3-in.

Velocity in channel ahead and beyond screen is 1.5 ft. per sec.

Incoming sewer 18-in. in diam.

During maximum flow the sewer flows full

During average flow the depth of sewage in the sewer is 8-in. (determined by sewage flow diagram)

Maximum allowable head loss thru the screen is 10-in.

Maximum velocity thru screen parallel to flow is 2.25 ft. per sec.; perpendicular to screen is 1.5 ft. per sec.

Solution of Problem

Net screen area

= 2 x cross section area approach sewer

$$= 2 \times \frac{\pi d^2}{4} = \frac{2 \times 3.1416}{4} \times 1.5^2 = 3.53 \text{ sq. ft.}$$

Net width of channel

$$= \frac{\text{Area}}{\text{Pipe Dia.}} = \frac{3.53}{1.5} =$$

2.35 ft. (use 29 in. or 2.42 ft.)

Number screen bars

$$= \frac{\text{Width Channel}}{\text{Clear Opening}} + 1 = \frac{29\text{-in.}}{1\text{-in.}} + 1 = 30 \text{ bars}$$

Size of bars ⅜-in. × 3-in., total bar width 30 × ⅜ = 11.25-in.

Total width of channel = 29-in. + 11¼-in. = 40¼ inches = 3.35 ft.

Velocity in channel ahead of screen 1.5 ft. per second to prevent deposition of organic solids.

Cross-sectional area of sewage in channel:

At average flow

$$= \frac{Q \text{ (cu. ft. per sec.)}}{v \text{ (ft. per sec.)}} = \frac{1.547}{1.5} = 1.03 \text{ sq. ft.}$$

At maximum flow

$$= \frac{2.5 \times 1.547}{1.5} = 2.57 \text{ sq. ft.}$$

Depth of sewage

$$= \frac{\text{Cross-sectional area sewage}}{\text{Width of Channel}}$$

At average flow

$$= \frac{1.03}{3.31} = 0.31 \text{ ft. or } 3\tfrac{3}{4} \text{ in.}$$

At maximum flow

$$= \frac{2.57}{3.35} = 0.77 \text{ ft. or } 9\tfrac{1}{4} \text{ in.}$$

Depth in approach sewer at average flow 8-in. (from diagrams).

At maximum flow sewer is full or depth = 18-in.

Net screen area = net width of channel × depth of sewage

At average flow

= 2.42 x 0.31 = 0.75 sq. ft.

At maximum flow

= 2.42 x 0.77 = 1.86 sq. ft.

Velocity through screen parallel to flow

$$v = \frac{Q}{A} = \frac{\text{Flow}}{\text{Net Screen Area}}$$

$$v \text{ at average flow} = \frac{1.547}{0.75} = 2.06 \text{ ft. per sec.}$$

$$v \text{ at max. flow} = \frac{2.5 \times 1.547}{1.86}$$

= 2.07 ft. per sec.

Velocity through screen perpendicular to screen. Screen set at slope at 45 degrees from horizontal.

At average flow

$$v = \frac{Q}{1.4\,A} = \frac{1.547}{1.4 \times 0.75} = 1.47 \text{ ft. per sec.}$$

At max. flow

$$v = \frac{1.547 \times 2.5}{1.4 \times 1.86} = 1.48 \text{ ft. per sec.}$$

Loss of head through screen

$$h_e = \frac{V^2 - v^2}{2g} \times \frac{1}{0.7}$$

V = velocity through screen = 2.06 and 2.07 ft. per second.

v = velocity in channel ahead of screen = 1.5 ft. per second.

$$h_e = \frac{V^2 - v^2}{2g} \times \frac{1}{0.7} = \frac{206^2 - 1.5^2}{2^4 \times 32.2} \times \frac{1}{0.7}$$

$$= 0.044 \text{ ft.} = \frac{9}{16} \text{ in.}$$

Total depth of sewage in channel ahead of screen

At average flow

= 0.31 + 0.04 = 0.35 ft. or 4¼ ins.

At max. flow

= 0.77 ft. + 0.04 ft. = 0.81 ft. or 9¾ ins.

Slope of effluent channel beyond screen. Velocity in channel to be 1.5 ft. per sec. Coefficient of roughness n = 0.015.

Using Chezy formula $v = c\sqrt{r\,s}$

v = velocity

c = Kutters Coefficient

r = hydraulic radius = area/wetted perimeter

s = slope

Cross-sectional area of the sewage in the channel during average flow = 1.03 sq. ft., and at maximum flow = 2.57 sq. ft.

Wetted perimeter = width of channel + 2 times depth sewage

W.P. = w + 2d = 3.35 + (2 x 0.31) = 3.97 ft.

$$r = \frac{\text{area}}{\text{wetted perimeter}} = \frac{1.03}{3.97} = 0.26$$

s = .0017 ft. per foot (by diagram)

By-Pass

A by-pass is a channel used to conduct sewage around the screen in the event that the screen becomes clogged, or during any other operating contingency. The by-pass entrance consists of an overflow weir protected by vertical bars. The effective area of the openings to the by-pass channel are designed as 2 to 3 times the area of the approach sewer.

Use ½-in. square vertical bars spaced to provide 4-inch clear openings; gross screenings only are to be removed.

Use a width which is a multiple of center to center spacing of bars.

The total width should be not less than the width of the screen chamber channel.

Place bars 4.5 inches from center to center. Use 11 openings or 10 bars.

Total width

= 11 × 4.5 = 49.5 inches

Net width

= gross width minus total bar width

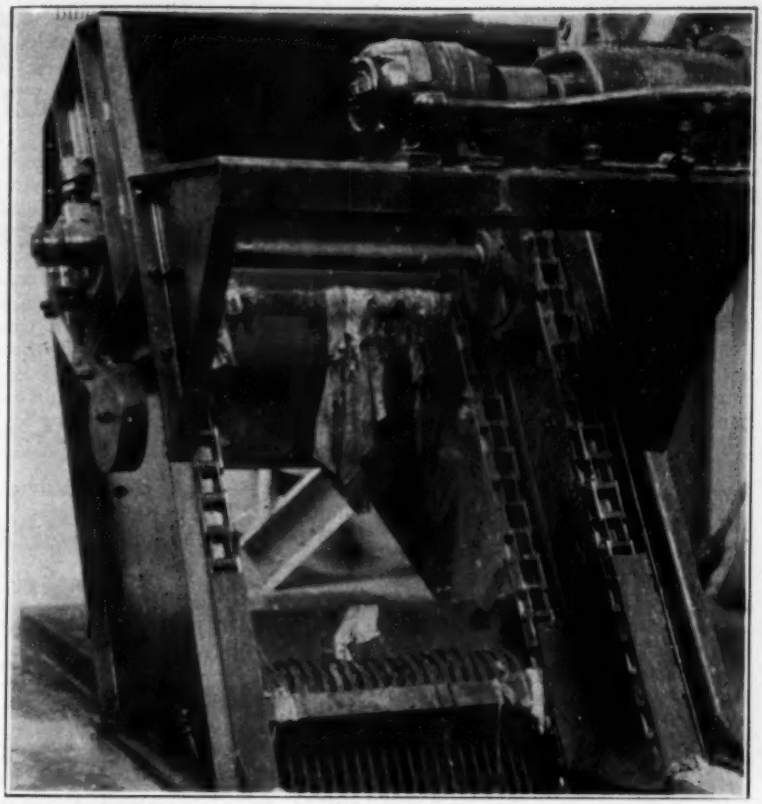
= 49.5 — 10 x 0.5 = 44.5 inches = 3.71 ft.

$$\text{Depth} = \frac{\text{net screen area (sq. ft.)}}{\text{net width of bypass opening (ft.)}} = \frac{3.53}{3.71} = 0.95 \text{ ft.}$$

Use a depth of 12 inches.

Additional Design Details

Many details, often considered unimportant and consequently neglected in design, actually are important. These details may be of material assistance in securing proper operating results and in maintaining satisfactory conditions at the screens and in screen chambers.



AUTOMATICALLY cleaned screen at Harlem Village, N.Y., State Hospital. Note accumulation of rags.

The bars of manually cleaned racks should be extended several inches beyond the top of the draining platform. When this is done, screenings can be raked over the top of racks and will not fall back into the channel.

The screen should not rest directly on the concrete platform and channel floor; steel supports properly anchored to the platform and channel concrete are preferable. The upper support may be made of a 4-in. x 3½-in. x ⅜-in. angle and a 3-in. x 3-in. x ⅜-in. angle placed back to back, and anchored to the concrete slab by ⅝-in. round anchors. A 5-in. x ⅜-in. x ½-in. angle, grouted into proper position in the screen channel, may be used for the lower support.

With mechanically cleaned bar screens, a substantial angle iron frame should be provided. The screen should fit closely along the sides. When screens are in sections for ease in handling, set-screw spacers placed in the end members will insure that no openings are greater than the space between bars.

The operating platform should be at least 5 feet square, so that raking operations are not restricted and sufficient space is available for screenings receptacles. With automatically cleaned screens, the draining platform may be smaller. A suitable strainer should be provided in the operating platform to allow the liquid to drain back into the channel. A 30-in. manhole frame with a slotted cover will be found satisfactory. The platform slab should be pitched towards the strainer, and a 6-in. curb should be provided on three sides of the platform to confine drippings and washings to the screen chamber.

If the screen chamber is constructed integrally with a sedimentation tank, a hand railing along the edge of the tank is desirable as a safety measure. The platform slab is designed for the loads that are expected to be placed upon it. Generally a load of 200 pounds per sq. ft. will be sufficient, if definite load information is not available.

Removing Screenings

Substantially built, reinforced garbage cans may be used for receiving the screenings. A can having a capacity of approximately 2½ cu. ft. will be found satisfactory. These cans

may be constructed of 16-gauge steel, and should be equipped with heavy handles and suitable steel covers. The cans and covers should be hot-dip galvanized after assembly. When cans of screenings must be moved from screen chambers located below the ground surface, a telescopic, manually operated, overhead crane hoist will be found advantageous for lifting the cans.

Means of washing the platform and screen chamber are essential to all installations. When the screen chamber is not housed, a nearby hydrant connection may be used. In screen houses, several conveniently located hose bibs should be installed. The hose bibs should be of brass, and should be connected to the water supply with genuine wrought iron pipe.

Protective Coatings

All steel used in the screen room should be painted with a shop coat of red lead and oil prior to being shipped. It is desirable that all exposed metal work in the screen room be painted with three field coats of bituminous paint, such as Nitrose. Floors, walls, ceilings and all other exposed concrete work are best protected by three coats of a cement paint, such as Bay State. The final coat should give a gloss finish. No paint containing lead should be used for any of the field coats. All gears, chains and other dangerous moving parts must be properly protected by guards.

Automatic screen cleaning equipment should be tested after installation. A test run of 48 to 96 consecutive hours, with all appurtenances adjusted, generally is specified. Any defects that develop during the test should be corrected, and the test run again. No time of operation prior to the development of a defect is counted in the specified test period. If insufficient sewage is available at the time of test, paper, rags and other material may be added to water to test the effectiveness of the equipment.

Employee Suggestion System for the Small Plant

A simple and practical suggestion system may well be used to the advantage of all concerned, even in the small plants. It will show employees that management is genuinely interested in their ideas of how improvements and savings might be made in operation, maintenance, store-keeping, office operation, etc. The "Suggestion Box" is an excellent means of passing suggestions on to management.

From the Sup't. of Documents can be procured a new booklet (19 pages illustrated) which tells the basic principles for successfully starting and operating **"A Suggestion System for the Small Plant."** It warns of pitfalls to avoid and gives examples of how the suggestion system has proved its worth. Send 15c (not in stamps) to the Sup't. of Documents, U. S. Govt. Printing Office, Washington, D. C. Ask for Catalog No. SDP 1.2:Su.3, giving also the above title to further insure receipt of the correct booklet.

Meter Reader's Occupation is Hazardous One

Anyone who has bumped his head will sympathize with Edward A. Mooney, a meter reader for the Kansas City, Mo., water department, who bumped his head so hard it broke his neck.

Mooney had just finished checking a meter in a dark basement when, as he started to leave, his head struck a beam on the basement's low ceiling.

He started to check other meters in the area but felt so ill that he telephoned to Louis Roose, safety engineer of the water department. "My head hurts like the dickens," he told Roose, "and my eyes burn. I think you'd better come out here." Roose picked up Mooney and drove him to a clinic where X-rays were taken.

Mooney received the bad news late yesterday—he had suffered a fractured vertebra of the neck, and a very touchy one at that. He was taken to a hospital where his neck was placed in traction.

Research on Cloud Seeding by Two Universities

Clouds as a possible untapped water resource in the arid Southwest will be studied intensively in a scientific research program operated jointly by the University of Arizona and the University of Chicago.

"And—some folks say that rain is only good for making things grow and filling reservoirs."

Establishment of an Institute of Atmospheric Physics at the University of Arizona at Tucson, initially manned by University of Chicago scientists, is aimed at determining how much the future development of dry regions throughout the world can be enhanced by efforts to stimulate additional rainfall.

The new institute will be financed partly by State funds and partly from private funds, chiefly those provided by the Sloan Foundation and by other sources.

Radar provides the best means of observing the behavior of clouds, the Chicago meteorologists find, because it can penetrate clouds like X-rays do hospital patients to reveal what is going on inside. Certain types of radars developed in World War II show a radar echo from clouds just at the point when the cloud droplets begin to grow big enough to cause rain.

Dept. of Water Resources Recommended for California

California's water problems are big enough to warrant creation of a State Department of Water Resources at the next legislative session, the water resources committee of the County Supervisors Association of California has concluded.

Main feature of the report submitted by this committee was a recommendation that all water matters of State responsibility be co-ordinated in a State Department of Water Resources, thus giving water problems the same rank as highways and other public works.

A bill creating such a department was passed last year by both houses of the Legislature but did not reach Gov. Warren's desk.

SEWAGE WORKS PRACTICES

Trickling Filter Operation

Eighth in a Series

by **DON E. BLOODGOOD,** ***Professor of Sanitary Engineering***
Purdue University, Lafayette, Ind.

AS the trickling filter does not bear the name of any inventor, it is not easy to trace the development of this unit from the first conception of the idea. It is probable that the present day trickling filter is an outgrowth of the slow sand filter used in the purification of water. Certainly the trickling filter is not to be considered a mechanical device for sieving out the solids in sewage, as the openings between the filter stones are large and cannot possibly remove the solids by straining action.

For many years it has been incorrectly stated that "a stream will purify itself after flowing twenty miles." It is true, however, that a polluted stream *will* purify itself when the distance of flow is adequate and when no new pollution is added. The stones and debris in a stream undergoing purification become coated with slime, indicating that this material is being instrumental in the removal of organic matter from the polluted water. It was probably due to observations on the self-purification of streams and on the clarifying action of water filters that prompted engineers to duplicate nature in the confines of an engineering structure.

The first experimental filters in the United States were built of gravel at the Lawrence Experiment Station of the Massachusetts State Board of Health in 1889. A small experimental filter was built at Madison, Wisconsin, in 1901 and the first municipal installation was made in Atlanta, Georgia, in 1903. Following since these early installations, the trickling filter has won general acceptance, and has become the method of sewage treatment most widely used.

Function of the Trickling Filter

Coarse bar racks, grit chambers, and primary or Imhoff tanks have been described as units that remove some of the suspended solids in raw sewage. Solids that remain in suspension after sewage has been retained in a settling tank for an hour or two are very small in size but, pound for pound, the fine solids contribute as much pollution as do the coarser solids that settle out in primary or Imhoff tanks. Sewage also contains dissolved solids that cannot be removed by sedimentation. The organic dissolved solids will decompose when discharged to a stream and will cause a corresponding pollution load. The organic dissolved solids are difficult to remove physically; even chemical coagulation will not remove many of the dissolved solids from sewage.

It is the primary purpose of a trickling filter to remove from sewage the finely divided suspended solids and the dissolved solids which remain after primary settling.

Materials of Construction

The trickling filter is composed of materials that provide large surface areas on which the micro-organisms may be retained. The organisms are not unlike those generally found in streams where natural purification is taking place; they must be found almost everywhere, and the desired growth occurs if sufficient food and proper environment is provided.

Most trickling filters have been constructed of crushed rock, though filters have been made of practically every inert material imaginable. For small installations, lath and brush have been used. There are in existence filters made of tile, coal, tin cans and slag. Many of these materials have operated successfully, so it may be concluded that the surface on which the organisms grow is of no particular importance. Different depths of filter beds have been studied, and common practice has finally led to the use of a bed about six feet deep. That depth has been selected by observing the quality of effluent from plants where good results were obtained when treating domestic sewage.

It is the purpose of the stone or other material to provide the surface area on which the micro-organisms can grow. It seems reasonable that the greater the surface area of the media, the more extensive would be the growth of a micro-organism population within a given volume of bed. This means that the smaller the diameter of the medium (such as stone), the greater surface area there will be in the bed. As an illustration, a cubic foot of stone two inches in diameter will provide twice as much surface area as will a cubic foot of stone four inches in diameter. The total volume of air spaces in each case remains the same; they are smaller in volume, but greater in number in the bed where the two inch stones are used. Proper aeration is very important in the operation of trickling filters.

Aeration of Filters

The micro-organisms living on filter stones are types that require oxygen from the air for their existence. The amount of oxygen required by these organisms is not exactly known, but it is believed that it is necessary to have a free circulation of air through the bed at all times. There have been a few trickling filters so constructed that the draft through the filters can be noted as air movement in the gallery housing the channels collecting the liquid from the underdrains. Some design standards require that only half of the depth of the underdrains should be used to discharge effluent, the remaining space being available to move air into or out of the bottom of the filter.

Dorr Co. Photo

TWO-STAGE trickling filters at Oklahoma City's 25 mgd plant
Provides high degree of treatment required by low seasonal dilution of effluent.

Numerous filters in operation today can be ventilated only by a few 6-in. diameter tiles leading from the underdrains, chimney-like, to the surface of the filter. These filters often have submerged filter effluent drains, so that no air can enter at these points. It may be argued that some of these filters operate satisfactorily, thus the design must be suitable. However, these filters might operate even more efficiently if they were properly ventilated, or they might treat a heavier load of sewage if they had a sufficient supply of air.

Types of Trickling Filters

There are two general classifications of trickling filters: (1) the standard rate filter, and (2) the high rate filter. The difference in these two types is basically the rate at which sewage is applied to the surface area. Usually the high rate filter utilizes the recirculation of some of the sewage through the plant to maintain a high surface application rate to the filter. The standard rate filter has been in common use much longer than the high rate filter.

Rate of Sewage Application

The removal of finely divided suspended solids and dissolved solids must occur very rapidly in a trickling filter, because sewage trickles over the bacteria and slime down through the stones to the underdrains in a short period of time. There have been various reports of the time required, some stating as little as ninety seconds, and others as much as several minutes. It can be concluded that, since it is necessary to bring sewage in contact with the slime on the stones, good distribution of the liquid is essential.

In the past, it was believed necessary to apply sewage to the filter, to allow it to trickle down through the stones, and then to provide time for the microorganisms to consume the food that had been adsorbed as the sewage flowed over the stones. Present day standards of design provide that there should not be rest periods of longer than five minutes between dosing (applying settled sewage).

The higher the application rate, the more sewage is put on the surface per unit of time. High application rates are of value in that they keep excess slime and accumulated solids flushed off the stones, and keep spaces between the stones open for free passage of air. This indicates that it would be desirable to have high application rates—but it must be remembered that the microorganisms must be given time to utilize the food being supplied by the sewage. Thus, there must be a sufficient accumulation of slime to utilize all the polluting material in the sewage.

There is value in having a high rate of sewage application, to keep the openings between the stones flushed clean, and there is value in having an even and continuous rate of application to the filter, to provide sufficient growth of slime. As both objectives can not be achieved at the same time, a compromise must be reached.

Effect of Temperature

Temperature affects the activity of microorganisms, their activity increasing markedly with rising temperature. Therefore, trickling filters can be expected to operate with more efficiency in the warm weather than they do in cold. In most locations, sewage is well above the freezing temperature—even though ice may sometimes form on the surface of filters. While the average temperature within a filter usually is well above freezing during cold periods, under such operating conditions, however, the environment is not optimum for the growth and feeding of organisms. Filters in cold areas, therefore, will not produce as good an effluent in winter as they do in warm months.

Operation of Filters

The need for good distribution of sewage over the filter has been emphasized. To accomplish this, the plant operator must be sure that the siphon chambers operate periodically as they were designed to operate. Minor stoppages in the siphon chamber vents sometimes cause continuous flow to take place. This should be corrected at once.

No matter how well sewage is screened and settled, some material of large size will pass through the system and lodge in the orifices or nozzles of the distribution mechanism. Nozzles should be cleaned regularly,

so that they never become clogged.

Rotary distributors should be so well balanced and lubricated that they will move as soon as sewage starts to flow from the openings in the arms of the mechanisms. Sometimes growths of slime develop on the distributor arm deflecting plates, and the result is that sewage is not evenly distributed over the bed. In such cases, slime should be brushed from deflecting plates as soon as it appears.

Ponding of Filters

Ponding of trickling filters may be a serious problem, and there are numerous causes for sewage to collect on the top of the filter. Sometimes this takes place because care was not used in placing stone in the bed, in such cases many fines (small stones) fill the spaces between large stones and there is no means of carrying away the excess slime that is loosened from the stones. When the spaces between stones become clogged, the sewage cannot flow through the bed to the underdrains. Only one way has been found to permanently correct such a situation—to remove all stone from the filter, screen out the fines, and replace the large stone in the bed.

Ponding may develop when the supplied sewage contains a higher-than-normal quantity of organic matter. As a result a large quantity of slime will be formed in proportion to the volume of sewage being applied to the filter. Thus, there is insufficient liquid volume to keep the filter flushed out. In such instances, recirculation of effluent can be very helpful in keeping the filter open and in good operating condition. In some cases, plant operators have temporarily corrected a ponding situation by flushing the surface of the filter with a powerful stream from the nozzle of a fire hose. Clarified sewage effluent has been found to be very satisfactory for this purpose.

SINGLE-STAGE Biofiltration plant treating 3 mgd at Port Washington, L.I., N.Y.
Effluent is discharged to a bay circled with beaches and yacht clubs.

Filter flies are a troublesome problem to many plant operators. The flies and the larvae that live within the filter do not appear to interfere with the quality of effluent produced, but the flies may be a nuisance at and near the plant. The flies are small moth-like creatures, not dangerous to the health of people that come in contact with them, but the flies may be present in enormous numbers and extremely annoying to plant operators. Spraying infested filters with D.D.T. has controlled the nuisance in some instances; flooding the filter periodically has been successfully used to kill larvae and to give temporary relief. Sometimes a strain of these flies develops that is immune to D.D.T. It is then necessary to resort to applications of benzene hexachloride, one of the more recently developed and more effective insecticides.

Summary

1. Trickling filters remove both dissolved solids and finely divided suspended solids from the applied sewage.

2. There must be ample spaces between the stones to permit proper aeration of a filter bed.

3. Proper distribution of sewage over a trickling filter is very important if the filter is to operate efficiently.

4. At low temperatures, the rate of biological activity in a trickling filter is decreased.

5. Ponding filters will produce a poor quality of effluent.

6. Trickling filter flies can be controlled by flooding or by spraying with insecticides.

New Plan to Provide Water for Chicago Suburbs

(Excerpts from an Editorial in the Chicago Tribune)

An old plan to use the Des Plaines river as an aqueduct for a water system serving western and northwestern suburbs has been revived by two consulting engineers. They would set up a public utility which would pump water from Lake Michigan into Lake county streams that would carry it to the Des Plaines river. Five filtration plants would be established along the river, with water mains leading to suburbs from Libertyville to Riverside.

The promoters estimate the cost of the project as $8,335,000 and predict that water could be supplied to suburban communities for 12 cents a thousand gallons, the same price charged by the city of Chicago to suburbs within the sanitary district.

It may be doubted that suburbs will rush to join in this enterprise. The Des Plaines river is a filthy stream that often becomes a mere trickle in the summer. Storm sewers of many towns along the banks discharge into the river. . . . Filtration plants might be able to take water from the Des Plaines and produce a beverage that would be safe for drinking. . . . The best that can be said for this plan is that it may help to focus attention on the necessity for joint action by the suburbs to secure adequate water supplies. . . . A study of the problem, we believe, could not fail to show that the best solution would be one water system for the metropolitan area.

The governor's help in this matter will be welcome. Not many problems on his desk are more important for the future welfare of the Chicago area.

"Good Medicine"

Good "medicine" for stopping the hiccups, they say now, is a long-lingering soul kiss.

Explanation: most cases of hiccups are of mental origin and can be stopped by diverting the mind.

About Salaries—More or Less

An Open Letter from One Water Works Man to Another

Dear Bill—

I have been concerned for some time about the comparatively low salaries we plant superintendents receive. Somebody had better give serious thought to this situation, it seems to me, and come up with a realistic answer. Have *you* discussed the living problem with your shift operators and maintenance men?

I recently questioned Tim, our day shift operator, about how he manages to pay medical and dental bills, in addition to meeting food, housing and clothing expenses. There are no children in our family, but *we* find our living costs a real problem. I didn't know how Tim could do it, because he has three nice daughters and takes home less pay than I do. He told me that dental work and eye glasses for him and his wife had been postponed and that clothing for the children comes first. His wife works as a waitress at times to supplement the family income.

Where the Responsibility Belongs

Naturally, we are not alone. Everyone wants to be as highly paid as possible. The question I've tried to answer is, where did this low wage business for water works men get started? My suspicions were aroused as I was looking through the original specifications for our plant. The consulting engineers, Brooks and Mason, had included salary recommendations for the superintendent, shift operators and one maintenance man. These salaries seem low to me; with an investment of nearly a million dollars in our plant, I figure the superintendent should be worth more than the $3,600 per year specified.

The 20,000 people in this community depend on me for a safe water supply. This is a sizable responsibility, considering that our raw water supply really is polluted and we must operate a complete treatment plant, including softening and disinfection.

My boys received a salary increase this year. Do you know why? Because the Water Board "Super" (my boss) hinted one day that if the new mayor gave the police force a raise, the Water Board would give the plant operators the same money. Now, I'll admit that the boys in blue needed a raise, but why couldn't my boss consider the operators on the merits of their own situation?

More than Enough Work for Everyone

Those original specifications and recommendations of the consultants got the wage levels off to a bad start, because the Water Board believed eight years ago that the new water treatment plant could be operated with the dollars and manpower recommended. In order to do so, they expected me to make all the chemical and bacteriological analyses in addition to operating the plant—so that each of the three operators could take one day off per week. We work holidays, too, you know, and someone has to be here 24 hours of the day. We finally did employ a fourth operator, but vacations are still awkward to schedule. The operators have to do all the janitor work in the plant and help unload truckloads of chemicals. In my opinion, the operators need and deserve more money, and we need more help at the plant.

The maintenance man is overworked too. He is responsible for all repairs to the whole distribution system, as well as for keeping the pumps and other machinery in operation.

Yes sir, it would be a good lesson for a few of these consulting engineers to be shift operators in a water treatment plant for a while. They would have difficulty maintaining themselves in the community on the wages we receive.

What Is the Final Result?

It could be that consultants estimate low operating and manpower costs to attract certain jobs. Municipal authorities *have* to pay the going price for machinery and equipment which meets specifications, but they certainly are unrealistic in expecting to hire qualified men at low wages.

I'm certain you will agree that, in the long run, this situation hurts the consulting engineers as well as the water works industry. Eventually, men like ourselves will advance to utility managership where it will be part of our job to retain consulting engineers for our utilities. Our choice will reflect experiences, such as shopping for capable men at an unrealistic wage level.

Keep in mind, too, that the same situation exists at our sewage treatment plants. Younger men certainly will not accept low paying jobs in the field of sanitation, as long as jobs with higher pay are available elsewhere—often with less responsibility. There is a continuing and desperate need for young blood and new ideas in this business.

What do you think?

Best regards,

John

Cloud Seeding Reported to be Big Business

Cloud seeding is well out of the stunt stage and is becoming a big business, Dr. Irving P. Krick reported to a Milwaukee, Wisc., meeting at Polytechnic Institute in observance of Engineers Week.

There are two dissimilar groups engaged in cloud seeding, he said. One he calls the "experimentalists"—those whose interest is primarily scientific and who spot seed in an effort, more often than not, to produce rain where there is no rain at all. The other is composed of "engineers" who seed clouds commercially.

He explained that the "engineers" undertake large-scale seeding, attempt to raise the percentage of precipitation where storm conditions already obtain, and, because of their extended operations, are able to collect more data than the "experimentalists."

The engineer showed little patience for attempts to produce rain from clouds where there is no rain. "Double nothing is still nothing," he said.

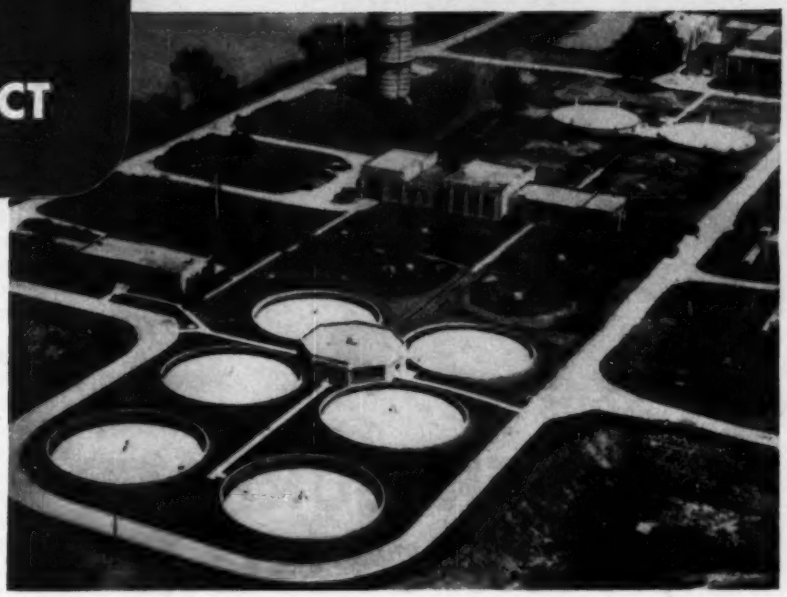
Ground Water is "Mined" in Certain Locations

In a report to the water resources section of the Mid-century Conference on Resources, held in Washington, D.C., ground water was described as "mined" in West Texas. J. R. Barnes of Austin said in that area the average rate of water withdrawal is thirty times the annual recharge rate. Studies indicate that in one-third of the area from West Texas to California, water is being pumped out faster than natural recharge takes place.

The country would not be in such a mess today if the Indians had adopted more stringent immigration laws.

ACCELERATED SLUDGE DIGESTION NOW A FACT

at the Columbus, Ohio Sewage Treatment Works



CRP

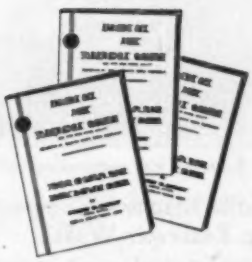
CATALYTIC REDUCTION PROCESS

The Catalytic Reduction Process* has been installed at the Columbus, Ohio Sewage Treatment Works. The Process has increased digester capacity. For treatment plant expansion in the near future, it will not be necessary to build additional digesters. The Catalytic Reduction Process applied to one 70′ tank at the Columbus plant increased total digester capacity by the equivalent of three tanks.

This is possible because the Process completes biological sludge digestion with solids loading rates three to four times conventional past practice. The tank operating under the Process produces the required reduction of volatile solids, normal gas production, and a readily driable odorless sludge.

Originating in 1946, the Process was developed, tested and verified over six years on both laboratory and pilot plant scale. The results obtained in the pilot plant operation have been proven in full scale plant operation at the Columbus, Ohio installation.

The Catalytic Reduction Process is now available for consideration by consulting engineers for application on plants under design and for plants requiring expansion.



Reprints of the paper by Professor P. F. Morgan on the development of this Process, and a paper by Mr. James H. Blodgett on the Columbus installation are available on request.

*The only proven Process for accelerating biological digestion. (Patents applied for.)

The Catalytic Reduction Process is offered through the Catalytic Reduction Co., Inc. a subsidiary of the Chicago Pump Company.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

622 DIVERSEY PARKWAY — **CHICAGO 14, ILLINOIS**

Flush Kleen, Screw-Feller, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

6 Reasons why

PALMER SURFACE WASH SYSTEMS

are specified by water works engineers

1. **Prevent Sand Beds From Cracking.**
2. **Eliminate Mud Balls.**
3. **Save Wash Water.**
4. **Lengthen Filter Runs.**
5. **Higher Rates of Filtration.**
6. **Better Tasting Water.**

Write today for Bulletin 451 and a list of water purification plants that have gone modern.

STUART CORPORATION
516 N. CHARLES ST., BALTIMORE 1, MD.

Baltimore Consultants Recommend Development of Susquehanna Supply

Consultants on future water supply have advised in their report an immediate start on the planning of a $33,500,000 project to tap the Susquehanna River as a third water source to meet the increasing needs of the City of Baltimore and the metropolitan district.

The consultants, Dr. Abel Wolman, Gustav J. Requardt, and Harry B. Shaw, in their report also recommended extension and strengthening of the water distribution system in the city and in county areas supplied by the city at an estimated cost of $25,000,000, of which three fourths would be provided by the city and developed by the counties.

They estimated that water consumption would begin overtaxing the present supply from the Gunpowder River and the Patapsco River (now under development) by about 1962, and that the proposed Susquehanna source should be available by 1965.

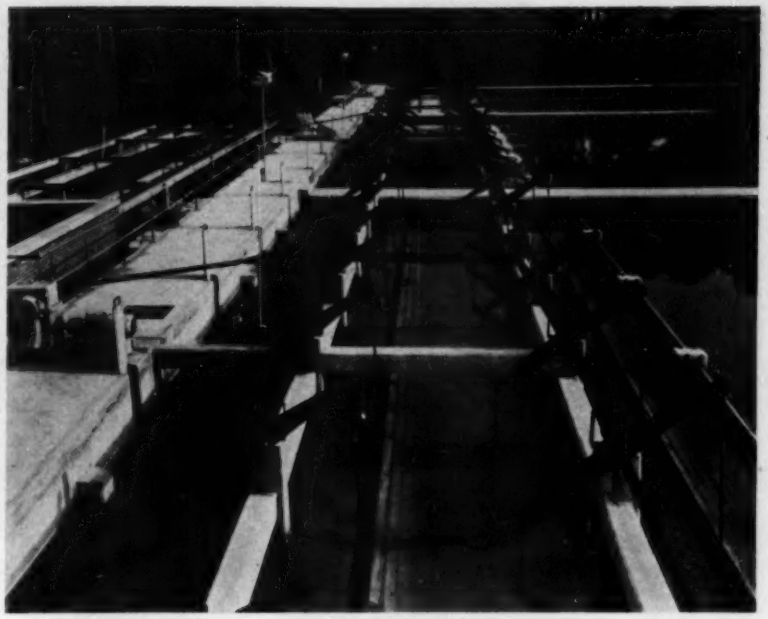
Reservoir wall compacting unit

Versatile Machine Compacts Steep Reservoir Walls

A rubber-tired roller mounted on end of a telescoping boom proved the right answer to a tough problem in compacting corners of steep sloping reservoir walls recently faced by Tyrrell & Davis Co., Pasadena, Cal. The company has a contract covering a wide variety of grading, excavating, trenching and compacting work at a $10 million steam plant under construction in the San Fernando

Valley by the Los Angeles Department of Water and Power.

The firm found corner areas were inaccessible to ordinary compaction equipment and turned the problem over to Robert McKession, engineering consultant, whose solution is shown in the illustration. He designed this 2,700-lb. rubber-tired wheel, which was mounted on the end of the boom of a Warner & Swasey Gradall. Using this combination, the contractor compacted slopes and corners easily and quickly. The versatile, multi-purpose machine also saved labor, and reduced costs on a number of other important jobs required by this big construction project.



Pickups from Purdue's "Sanitary Engineering News"

Don E. Bloodgood, Editor

Ultra-sonic apparatus has been used for tracing the position of deposits of septic sludge in lakes.

* * *

A recent statement in Public Works says that hemlock is a fine wood for baffles in septic tanks and that absorption field drainage-ways can be made with planks of this wood.

* * *

Circulation in the water distribution system of Fairbanks, Alaska must be maintained at velocities of at least 3 ft. per sec. to prevent freezing during the winter.—*Water & Sewage Works.*

* * *

Municipal sewage treatment standards have been completed for the 981 mile length of the Ohio River.

* * *

Foaming has been the most perplexing and troublesome problem at the Benton Harbor-St. Joseph, Mich. activated sludge plant since its completion.

* * *

In 1953 there were only 216 sanitary engineering graduates from the colleges and universities of the country.

* * *

The Bergen County, N. J. sewage system is to serve 50 communities—probably a record.

* * *

The U. S. Service has an industrial waste guide, *Milk Processing Industry.*

* * *

Van Kleeck, in *Water & Sewage Works* says: "Every booster sewage pumping station should have one or more fire extinguishers of a design and capacity approved by the Underwriter's Laboratories."

6 Reasons why

WALKING BEAM FLOCULATION

is now specified by water works engineers

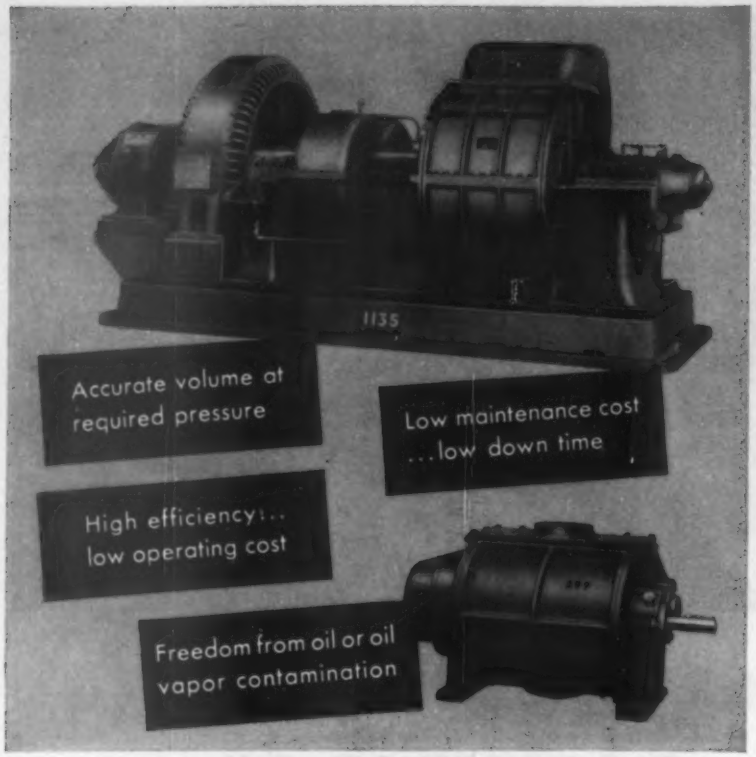
1. **Eliminates troublesome underwater bearings.**
2. **Eliminates expensive dry well construction.**
3. **All bearings accessible for inspection and lubrication.**
4. **Produces quick responsive floc formation.**
5. **Longer filter runs.**
6. **A saving in alum.**

Write today for Bulletin 451 and a list of water purification plants that have gone modern.

STUART CORPORATION

516 N. CHARLES ST., BALTIMORE 1, MD.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.


Accurate volume at required pressure
Low maintenance cost ...low down time
High efficiency!.. low operating cost
Freedom from oil or oil vapor contamination

LOOK FOR THE "BIG 4"

WHEN YOU BUY BLOWERS

Successful over-all performance of blowers calls for continuous, long-time ability to meet these basic requirements. In any specific case, one may be more important than another. But, when you select Roots-Connersville equipment, you sacrifice none of these four essentials. That is true, whether your requirements are for a whisper of air or for a tornado. You'll find the R-C range of capacities so extensive that you can very closely match your needs, with resulting economies in both first cost and operating cost. Further, you have the choice of either Rotary Positive or Centrifugal Blowers, from the exclusive R-C *dual-ability* line.

The ability to deliver blowers with these fundamental values comes from our century of specializing in problems of handling gas and air. The proof of this ability is readily found in our list of long-time customers who have gained complete satisfaction by entrusting their blower problems to Roots-Connersville. Ask us about your present or future needs in equipment to handle gas or air.

ROOTS-CONNERSVILLE BLOWER

Reg. U.S. Pat. Off.

A DIVISION OF DRESSER INDUSTRIES, INC.
434 Mount Ave. • Connersville, Indiana

BLOWER BUILDERS SINCE 1854

Specialists in handling gas and air

Russell, of U. S. Pipe, Dies

United States Pipe and Foundry Company, Birmingham, Alabama, has announced that Mr. Norman F. S. Russell, Chairman of the Board, died suddenly at his home in Edgewater Park, New Jersey on February 24.

Mr. Russell was born in Jersey City, New Jersey. After completing his primary and secondary school education, he attended and was graduated from Colgate University in 1901. Shortly thereafter he went with the financial firm of Colgate, Hoyt and Company in New York. Leaving that firm in 1910, he came with U. S. Pipe as a sales trainee in the Scottdale Plant. He then became successively salesman, sales agent, eastern sales manager, purchasing agent and general sales manager. In 1922, he was elected vice president, president in 1923 and chairman of the board in 1948.

Instrument Answers Phone and Gives Its Reading

401

The Bristol Company, Waterbury, Conn., has developed an instrument which makes it possible for an employee of a gas or water utility company to telephone a remote, unattended gas holder or water reservoir and get up-to-the-minute information on the storage conditions at any time of the day or night, from any telephone, even from a radiotelephone equipped truck.

Called the "Metaphone", the instrument can be installed at any point in a plant or system. It answers the phone when you call and gives its reading, not of course by voice, but by a time signal. The measuring system closes an electrical circuit for a length of time which is proportional to the height of the water in the tank, or to the pressure of the gas in the holder.

The electrical circuit includes a buzzer mounted before a telephone

(*Continued on page* 98A

Left: Unretouched photograph of clogged intake at the Old Badger Plant, City of Kaukauna, Wisconsin (not mechanically cleaned). Compare this with the New Badger Plant (at left).

New Plant mentioned in which intake is cleaned with a Leonard trash rack rake. Both plants draw water from the same canal.

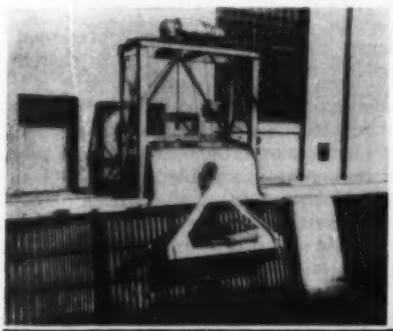
MAINTAIN *MAXIMUM HEAD*

SAVE POWER LOSSES AND OPERATING EXPENSES with the

LEONARD TRASH RACK RAKE

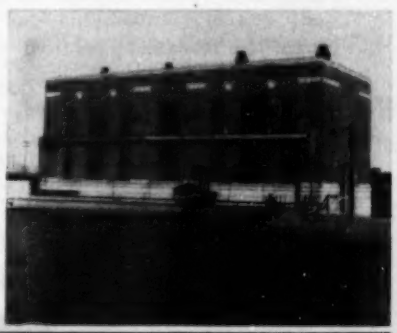
THIS DEVICE IS USED AT INTAKES TO HYDRO-ELECTRIC PLANTS, STEAM POWER PLANTS AND PUMPING STATIONS to remove river grass, lily pads, branches, logs, pulp wood, or other extraneous matter which gather on the racks to obstruct the water supply.

LEONARD raking equipment is specified by many of the country's leading Engineers, as well as public works agencies such as the U. S. Engineers, and Bureau of Reclamation. Write for our Bulletin 158 and list of installations.



Left: Leonard raking unit at the St. Mary's Falls Hydro-Electric plant, Michigan; a U. S. Engineers project.

Right: View of forebay and power house at the Thilmany Plant, City of Kaukauna, Wisconsin. In addition to the Leonard rakes at this plant and the New Badger plant, the City also has one at its Little Chute Plant.



POWER by SMITH — 16,000,000 HP

76 YEARS EXPERIENCE DESIGNING AND MANUFACTURING HYDRAULIC TURBINES AND ACCESSORY POWER PLANT AND PUMPING STATION EQUIPMENT

S. MORGAN SMITH CO. York, Penna., U.S.A.

(*Continued from page* 96A)

transmitter. Thus, when someone dials the unattended phone and opens the transmission circuit, he can hear the signal; by simply timing its duration with a stopwatch, he knows the condition of the storage tank. For instance, if a 60 foot high water tank is full to a height of 40 feet, the buzzer sounds for 40 seconds, then is quiet for 20 seconds, then repeats the 40 second signal.

The cost of installing and operating the device is considerably less than that of more conventional telemetering systems. Also, it is often more useful to a supervisor who doesn't stay in a central control room or pump house, but whose duties make it necessary for him to move about a plant or city.

Bossart Joins Koppers Tar Products Div.

Koppers Company, Inc., Pittsburgh, Pa., has announced that Walter L. Bossart has joined the company as Assistant Manager, Coal Tar Chemical Sales, in the Tar Products Division.

A native of Latrobe, Pa., and a University of Pittsburgh graduate, Mr. Bossart came to Koppers from the Office of Price Stabilization in Washington, D.C., where he had been for two years Chief of the Plastics and Adhesive Section of the Rubber, Chemicals, Drugs and Fuels Division.

During World War II he served as a chemical and drug specialist for the Federal government's U.S. Commercial Company, and from 1946 to 1951 was department manager of a Swiss chemical firm, with offices in New York City.

Wide World Photo

this could happen in your town

THIS CITY STREET CAVED IN when a water main broke. It's a dramatic, but not an unusual example of what water does to road bedding. Protect your roads and pipes from the problems of leakage by Centrilining. This patented process thoroughly cleans and centrifugally lines pipes with cement mortar. Leakage, tuberculation and interior corrosion are permanently checked . . . carrying capacity and distribution pressure are increased to "better than new" highs. And the whole process is done with pipes in place . . . no excavation . . . no traffic disruption. With Centrilining you can save your water mains . . . and streets too.

Write today for free booklet

CEMENT-MORTAR LININGS FOR PIPES IN PLACE

3,000,000 FEET OF EXPERIENCE

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET, NEW YORK 6, N. Y.

Branch Offices in Principal Cities of United States and Latin America

Pocket-Sized Magnet, A Recovery Tool

402

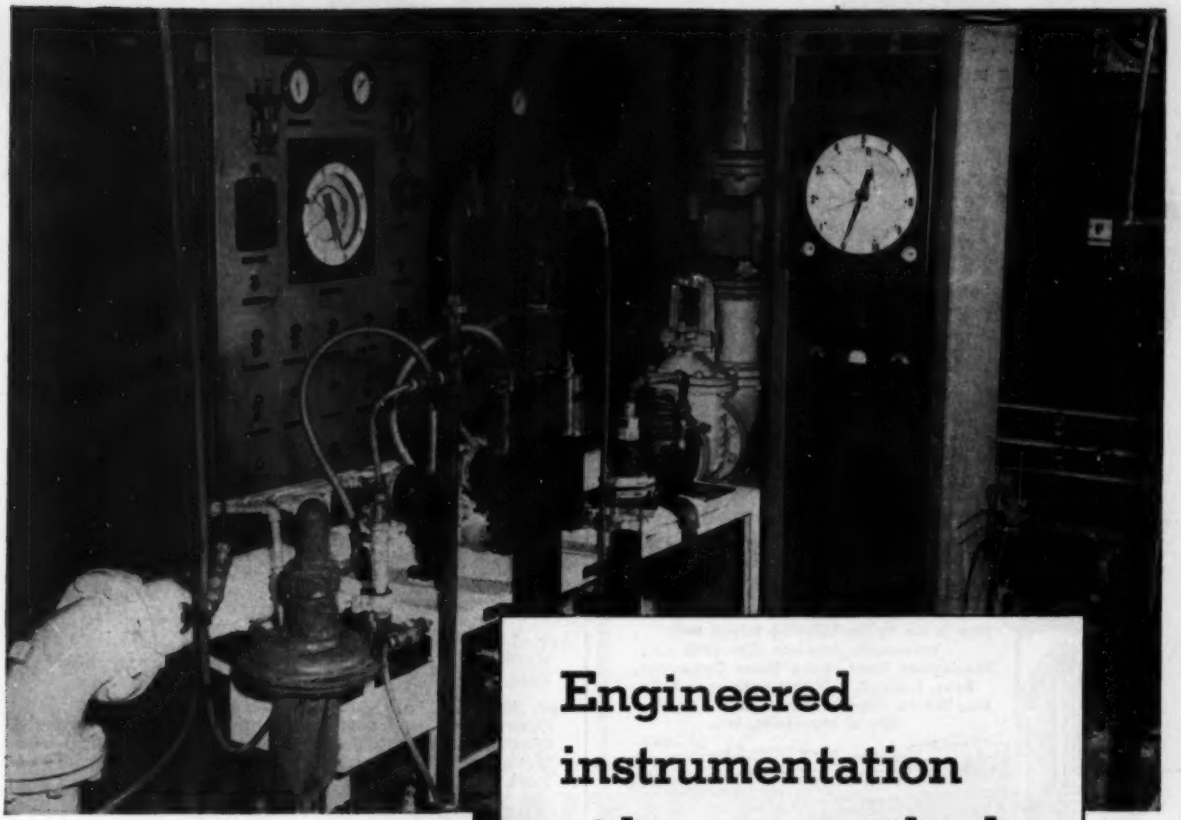
Eriez Manufacturing Company, Erie, Pa., has recently constructed a powerful little 4½" magnet to be used as a recovery tool for anybody who works with metal. Designed to attract and hold lost tools, parts or spilled pieces of metal from inaccessible places, the Eriez Recovery Magnet is already on the market and is proving a versatile retrieving instrument.

The magnet is of a "permanent" type . . . there is no electric current, wires, batteries, etc. It is a self-contained instrument made of powerful Alnico V and it is contained in a 1" non-magnetic stainless steel tube.

A non-removable, mild steel tapered plug is on the attracting end of the tube to provide sinking weight while on the other end there is a captive ⅛" standard pipe nipple drilled with a $\frac{3}{16}$" hole.

The hole allows a rope or wire to be passed through it so that the whole magnet can be lowered to great lengths in vertical pipes, in water, tanks, barrels, vats, etc. A coupling or reducer can attach any length pipe to the ⅛" nipple and the magnet can be shoved into places where simple gravity will not carry

(*Continued on page* 106A)



Engineered instrumentation aids new methods of waste treatment

INSTRUMENTATION used by General American Transportation Corporation is an excellent example of the modern trend toward fully automatic, continuous treatment of industrial wastes. Applied to the treatment of phenol and oil bearing wastes from tank car cleaning, this equipment affords pin-point accuracy capable of detecting phenol concentrations as small as 0.001 part per million.

In the installation pictured above, an *ElectroniK* pH Controller on the panel at left regulates the addition of either lime or acid to adjust pH of the effluent from the car cleaning shop. At the right is the phenol control panel, where an *ElectroniK* instrument with *Air-O-Line* control regulates the flow of oxidant in proportion to phenol concentration. The sensing element for this latter instrument is a continuous sampling optical detection system.

ElectroniK instruments analyze chemical concentration, make a permanent record of effluent characteristics, and automatically adjust the addition of reagents. By utilizing their precision and versatility in modern treatment systems, hundreds of plants are reducing the cost of laboratory analysis . . . cutting labor requirements . . . saving chemicals. Your nearby Honeywell sales engineer will be glad to discuss specific applications with you and your consulting engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● REFERENCE DATA: Write for Bulletin 7302, "Instrumentation for Water, Sewage and Industrial Waste Treatment."

MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls

HAVE AN ADEQUATE WATER SUPPLY ALL YEAR ROUND!

with the exclusive **RANNEY®**

WATER COLLECTOR FOR YOUR CITY

Now in use by the following volume water consumers: American Cyanamid Co., Wallingford, Conn.; Boise Water Corporation, Boise, Idaho; E. I. DuPont deNemours & Co., Inc.; Granite City Steel Co., Granite City, Ill. City of Manitowoc, Wis.

Millions of Gallons

The Ranney Collector is a unique kind of "well." It can produce more pure, cool water from one well, for less money, than ever possible before, with multiple wells. This greater yield adds millions of gallons to your present water supply, with fewer pumps and personnel. Installation and maintenance costs are held to a minimum.

Eliminates Filters

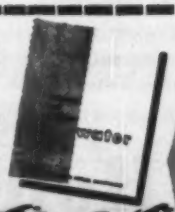
You can avoid the cost of maintaining an elaborate filter plant and water treatment station. The Ranney Method of water collection supplies a huge volume of naturally filtered water through exclusively engineered, screened horizontal well points that never clog. It pays to investigate the Ranney Method today!

I believe a Ranney Water Collector can save money for my community. Please send me further information.

Name_____

Company_____

Address_____



RANNEY METHOD WATER SUPPLIES, INC.
Water Supply Engineers and Contractors
841 Alton, Columbus 19, Ohio · Dept. WS 31

Meetings Scheduled

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Apr. 14—Norway, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Apr. 20—New York, N.Y. *(Manhattan College)*
CONFERENCE ON INSTRUMENTATION IN WATER, SEWAGE & INDUSTRIAL WASTE TREATMENT. Director, Brother Joseph McCabe, Civil Engineering Dept., Manhattan College, New York 71, N.Y.

Apr. 21-23—Houston, Tex. *(Hotel Shamrock)*
SOUTHERN INDUSTRIAL WASTES CONFERENCE. (Sponsored by Southern Assn. of Science & Industry, and Texas Chemical Council). Write, E. K. Hunt, American Cyanamid Co., Bound Brook, N.J.

Apr. 22-23—Watertown, N.Y. *(Woodruff Hotel)*
NEW YORK SECTION A.W.W.A. (Annual Spring Meeting. Registration evening of 21st). Sec'y Kimball Blanchard, 50 West 50th Street, New York, N.Y.

Apr. 22-23—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION A.W.W.A. Sec'y, E. Bruce Meier, University of Nebraska, Lincoln, Neb.

Apr. 22-24—Tucson, Ariz. *(Santa Rita Hotel)*
ARIZONA SECTION A.W.W.A. Sec'y, M. V. Ellis, Supervisor Sewage Treatment Plant, Phoenix, Ariz.

Apr. 22-24—Tucson, Ariz. *(Santa Rita Hotel)*
ARIZONA SEWAGE & WATER WORKS ASSOCIATION. Sec'y, M. V. Ellis, 46 Encanto Blvd., Phoenix, Arizona.

Apr. 22—Bozeman, Mont. *(Hotel Baxter)*
MONTANA SEWAGE & INDUSTRIAL WASTES ASSOCIATION, Sec'y Harry W. Taylor, Morrison & Maierle, Inc., Helena, Mont.

Apr. 23-24—Bozeman, Mont. *(Baxter Hotel)*
MONTANA SECTION A.W.W.A. Sec'y, A. W. Clarkson, State Board of Health, Helena, Mont.

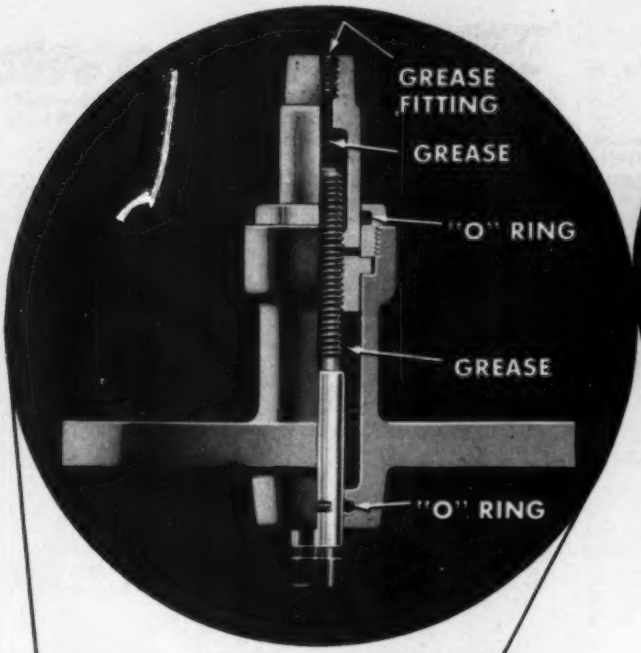
Apr. 22-23—Boston, Mass. *(Hotel Somerset)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, State Dept. of Health, Providence, R.I.

Apr. 29-30—Frederick, Md. *(Hotel Francis Scott Key)*
MARYLAND-DELAWARE WATER & SEWAGE ASSOCIATION. Sec'y, W. M. Bingley, 2411 N. Charles St., Baltimore 18, Md.

May 4-6—Chicago, Ill. *(Hotel Morrison)*
AMERICAN PUBLIC POWER ASSOCIATION. Exec. Sec'y, Alex Radin, 1757 K St. N.W., Washington, D.C.

May 5-8—Sacramento, Calif. *(Hotel Senator)*
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sam A. Weed, Room 315, City Hall, Oakland, Calif.

(*Continued on page* 102A)

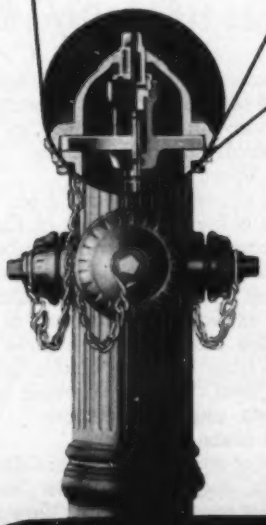


NEW DOUBLE FEATURE

48

SMITH HYDRANTS

WITH "O" RING-SEAL AND GREASE CHAMBER FOR OPERATING THREADS



When you specify "O" Ring Seals rather than conventional packing you reduce maintenance to a minimum. The lower "O" Ring is the pressure seal, the upper "O" Ring the dirt seal. The initial compression of the "O" Rings provides the seal when the hydrant is closed. When subject to water pressure the lower "O" Ring is forced to the top of the groove. The sealing force increases as the pressure increases. The specially compounded rubber plastic "O" Rings insure a long life pressure seal. Each time the hydrant is operated, the "O" Ring Seals, the bearing surfaces, and the operating threads are automatically lubricated. Threads and upper section of the stem are continuously lubricated and sealed from contact with water in the standpipe. The lubricant is suitable for temperatures of minus 30 degrees to 200 degrees. All Smith Hydrants including hydrants in service can be fitted with "O" Ring Seal Plates.

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE. NEW JERSEY

(*Continued from page* 100A)

May 7—Columbus, O. *(Ohio State University)*
ANNUAL CONFERENCE FOR ENGINEERS. Chairman, M. G. Fontana, Ohio State University, Columbus 10, O.

May 10-12—Lafayette, Ind. *(Purdue University)*
NINTH PURDUE INDUSTRIAL WASTE CONFERENCE. Director, Prof. Don E. Bloodgood, Purdue University, Lafayette, Ind.

May 20-21—Staunton, Va. *(Hotel Stonewall Jackson)*
VIRGINIA INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, J. L. Hamrick, Jr., 415 W. Franklin St., Richmond, Va.

May 23-28—Seattle, Wash. *(Exhibits and Technical Sessions—Auditorium)*
AMERICAN WATER WORKS ASSOCIATION. (74th Annual Convention). Exec. Sec'y Harry E. Jordan, 521 Fifth Ave., New York 17, N.Y.
(For hotel accommodations apply to A.W.W.A. headquarters office.)

May 25—Seattle, Wash. *(Norselander Cafe)*
PACIFIC NORTHWEST SECTION A.W.W.A. (Luncheon and Business Meeting). Sec'y, O. P. Newman, Boise Water Corp., Boise, Ida.

June 7-11—Columbia, Mo. *(University of Missouri)*
MISSOURI WATER WORKS SHORT COURSE. Director, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

June 9—Lubec, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

June 14-15—Syracuse, N.Y. *(Hotel Syracuse)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Executive Committee Dinner Sunday Evening June 13. Sec'y, R. C. Sweeney, State Dept. of Health, White Plains, N.Y.

June 14-18—Chicago, Ill.
AMERICAN SOCIETY FOR TESTING MATERIALS. Sec'y, Raymond E. Hess, 1916 Race St., Philadelphia 3, Pa.

June 14-19—Atlantic City, N.J. *(Chalfonte Haddon Hall)*
AMERICAN SOCIETY CIVIL ENGINEERS. Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

June 23-25—Allentown, Pa. *(Americus Hotel)*
PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, State Dept. of Health, Greensburg, Pa.

June 22—Boonton, N.J. *(The Knolls Golf Club)*
NEW JERSEY SECTION A.W.W.A. (Summer Outing). Sec'y, C. B. Tygert, Box 178, Newark, N.J.

June 24-26—Richmond, Ind. *(Hotel Leland)*
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, A. Paul Troemper, 2029 Bates Avenue, Springfield, Ill.

July 25-31—Sao Paulo, Brazil *(Univ. of Sao Paulo)*
INTER-AMERICAN CONFERENCE SANITARY ENGINEERING. Write to General Secretariat, Fourth Inter-American Conference San. Eng. Caiza Postal 8099, Sao Paulo, Brazil.

Aug. 11—Bingham, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 23-25—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y, R. R. Kountz, Pennsylvania State College, State College, Pa.

Aug. 25-27—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. S. Bush, Dept. of Health, Kirby Health Center, Wilkes-Barre, Pa.

Sept. 9-10—Montauk, N.Y. *(Hotel not selected)*
NEW YORK SECTION A.W.W.A. (Annual Fall Meeting). Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N.Y.

(*Continued on page* 104A)

from "expense" to "income" in one easy operation...

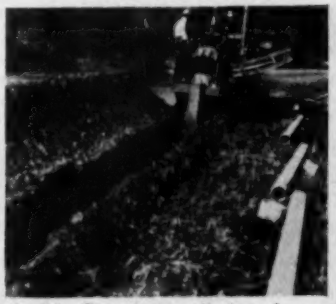
. . . the utilization of a Royer Sludge Disintegrator. And it *is* an easy operation; no expensive installation costs are involved; no specially trained labor is needed for its operation.

Sludge cake is shovelled directly from the drying beds into the low hopper of the Royer and is completely shredded, mixed, aerated and discharged, free of all trash, ready for use as a highly desired fertilizer. Instead of the expense of disposing of unwanted sludge cake, you will have a steady income from the sale of this nitrogen-rich plant food. It is in constant demand by florists and nurserymen, gardeners, golf clubs and parks.

Do as hundreds of sewage plants are doing —converting an "expense" into an "income". Write for a copy of the "Sewage Sludge Datalog" giving complete information on this profit-making operation and details on the sizes and types of Royers best suited to your needs.

ROYER FOUNDRY & MACHINE CO
170 PRINGLE ST., KINGSTON, PA.

Save time and money on water line installation



In this Georgia installation, faster line assembly permitted following the digger closely.

On this Utah job, snow, ice and frozen ground caused no installation slow-down.

In this California installation, flexible Ring-Tite joints permitted conformance to curves.

Transite® Pressure Pipe with the new Ring-Tite® Coupling

Goes together fast! Locks tight automatically!

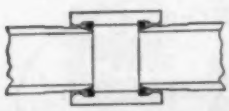
In state after state, community after community, water district after water district, Transite Pressure Pipe and the new Ring-Tite Coupling have made possible important cost-savings in installation time.

The Ring-Tite Coupling is effecting installation savings everywhere because of its special features. To begin with, pipes are aligned quickly, easily. Coupling design not only provides automatic aligning but also automatic adjustment for expansion. Rubber rings are simply popped into grooves for assembly; lubricated pipe ends then slide in under rings smoothly, easily, and surely.

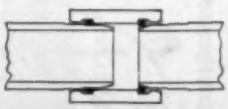
Pipe ends are automatically separated within the coupling. This separation gives the line flexibility to withstand shock and vibration, relieves line stresses, permits conformance to curves.

Like Transite Pressure Pipe, the Ring-Tite Coupling sleeve is made of asbestos and cement . . . it is strong and durable, cannot rust, and is highly resistant to corrosion. Installations can be completed under adverse weather, temperature or terrain conditions. No complicated equipment is required.

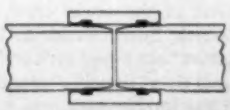
For more information write Johns-Manville, Box 60, New York 16, N. Y.



A. Rubber rings popped into grooves before assembly.



B. Lubricated pipe slides in under rubber rings.



C. Both pipes in assembled position. Rings compressed and locked in place.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE PRESSURE PIPE

AN ASBESTOS-CEMENT PRODUCT

(*Continued from page* 102A)

Sept. 15-17—Muskegon, Mich. *(Occidental Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, Dept. of Health, Lansing 4, Mich.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 420 6th Ave. N., Nashville, Tenn.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, R. Paul Farrell, 420 6th Ave. N., Nashville 3, Tenn.

Sept. 22-24—Dayton, Ohio *(Biltmore Hotel)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, Ohio.

Sept. 22-24—Regina, Sask. *(Saskatchewan Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, W. J. Waddell, 3610 Manchester Road, Calgary, Alberta.

Sept. 26-28—Jefferson City, Mo. *(Governor Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

Sept. 28-30—Green Bay, Wis. *(Northland Hotel)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison 3, Wis.

Oct. 4-6—Poland Spring, Me. *(Poland Spring House)*
NEW ENGLAND WATER WORKS ASSOCIATION. (73rd Annual Convention). Sec'y Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Oct. 4-6—Atlantic City, N.J. *(Chalfonte-Haddon Hall)*
PENNSYLVANIA MUNICIPAL AUTHORITIES ASSOCIATION. Sec'y, Claude C. Fogelman, 1717 Main St., Northhampton, Pa.

Oct. 6-8—St. Paul, Minn. *(Hotel not selected)*
MINNESOTA SECTION A.W.W.A. Sec'y, Leonard N. Thompson, Gen. Mgr., Water Department, St. Paul, Minn.

Oct. 11-14—Cincinnati O. *(Netherland Plaza Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATIONS. (27th Annual Convention). Exec. Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.
(In conjunction with)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT ASSOCIATION. Sec'y, Ward E. Conard, 301 Ohio Departments Bldg., Columbus 15, Ohio.

Oct. 11-15—Buffalo, N.Y. *(Statler Hotel—Tech. Sessions, Memorial Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting). Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N.Y.

Oct. 13—Brunswick, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 13-15—Cedar Rapids, Iowa *(Roosevelt Hotel)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 17-20—El Paso, Texas *(Cortez Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 18-22—New York, N.Y. *(Statler Hotel)*
AMERICAN SOCIETY CIVIL ENGINEERS. (Annual Meeting). Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

Oct. 19-22—Atlantic City, N.J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, David Dunlap, 504 N. Second St., Harrisburg, Pa.

Oct. 24-27—Birmingham, Ala. *(Tutwiler Hotel)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Charles W. White, State Department of Health, Montgomery, Ala.

Oct. 26-29—Long Beach, Calif. *(Wilton Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, H. F. Herauld, 1040 Mansanika Ave., Pasadena, Calif.

(*Continued on page* 114A)

ELYRIA, OHIO *Also* SAVES MONEY WITH "*Flexibles*"

Like most typical cities which are careful with the taxpayers' money, Elyria, Ohio, chose "Flexible" equipment. Pictured is their modern "Flexible" SeweRoder which takes 9/10ths of the usual hard work out of cleaning sewers – works faster and permits "preventative maintenance" to be carried on due to low cost of operation – without interference by the weather. (Some cities report cleaning sewers for less than 2¢ per foot.) Seen in the picture from left to right are Walt Decker and John Hovis of the city council, Henry Ault, Mayor, Ralph Terry, Safety-Service Director, Art of the sewer crew, and George Carrick, Superintendent. This city knows that "Flexibles" are based on careful study of the problem, and that "Flexible" stands behind every sale – as it has for 20 years.

Write for our **FREE** *Catalog*

Flexible **SALES CORPORATION**

3786 Durango Ave., Los Angeles 34,

(DISTRIBUTORS IN PRINCIPAL CITIES)

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

Here's proof! ONLY JOHNSTON OFFERS ALL THESE FEATURES *AT NO EXTRA COST!*

TURBINE PUMP SPECIAL FEATURES—OIL LUBRICATED ENCLOSED IMPELLERS

MAKE	VITRIFORM ENAMEL BOWLS	REPLACEABLE WEAR RINGS	DUAL BOWL BEARINGS BRONZE & RUBBER	SAND COLLARS	PRESSURE SEAL OIL TUBE	NPT SUCTION	COLUMN STRAIGHT THREAD BUTT STANDARD PIPE	VITRIFORM ENAMEL IMPELLERS	DISCHARGE COMPANION FLANGE	1 GALLON OILER WITH SOLENOID VALVE	TRIPLE IMPELLER SEAL
JOHNSTON	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
PUMP "A"	EXTRA CHARGE			YES	YES	YES		EXTRA CHARGE	YES	YES	
PUMP "B"				PART OF IMPELLER	YES	YES			YES	YES	
PUMP "C"	EXTRA CHARGE	EXTRA CHARGE		YES	YES	YES	YES	EXTRA CHARGE	EXTRA CHARGE	EXTRA CHARGE	YES
PUMP "D"	EXTRA CHARGE	REPAIRS ONLY				YES		EXTRA CHARGE	YES	YES	
PUMP "E"	EXTRA CHARGE	END SEAL YES	YES	YES	YES	YES	YES	YES	YES	YES	
PUMP "F"	EXTRA CHARGE	EXTRA CHARGE		YES	YES		YES	EXTRA CHARGE	EXTRA CHARGE	EXTRA CHARGE	
PUMP "G"				SO-CALLED SEAL	YES	YES		YES	YES		
PUMP "H"		CERTAIN SIZES ONLY			YES	YES			YES	1 PINT	
PUMP "I"						YES			YES	1 PINT MANUAL	
PUMP "J"	EXTRA CHARGE			YES	YES	YES	YES		YES	YES	

JOHNSTON VERTICAL PUMPS

NOTE: ***This information taken from available price book and printed literature.***

JOHNSTON PUMP COMPANY, 3272 EAST FOOTHILL BLVD., PASADENA 19, CALIFORNIA

(*Continued from page* 98A)

the magnet, such as retorts, horizontal pipe, elevated nooks and crannies, etc.

In steel pipes the magnetic attraction of the tool to the walls of the pipes is prevented by a feature incorporating two removable neoprene rings which slip around the recovery tube.

Cowan Appointed by Darling Valve

Darling Valve & Manufacturing Company, Williamsport, Pennsylvania, has announced the appointment of Mr. Joseph T. Cowan as District Representative in the Tulsa, Oklahoma territory.

Mr. Cowan is a long time resident of Tulsa. His previous experience has brought him in close contact with the Oil, Gas and Public Utility Industries in the Southwest.

New Valve Prevents Surge and Hammer When Filling Pipe Lines

403

Simplex Valve and Meter Company, Philadelphia, Penna., has developed a new Controlled Closing Valve to counteract the problems of surge and water hammer.

This new valve is said to prevent surge and water hammer damage when filling pipe lines, control speed of line closure, vent air and, if necessary, discharge water to prevent damage and admit air to protect against pipe collapse from line breaks.

The valve, called type CCAV, is furnished with a 4 inch diameter flanged inlet opening suitable for bolting directly to a 4 inch standard flanged fitting in the pipe line. The standard unit is composed of the air inlet and exhaust valve enclosed by and surmounted with a cast iron shell having a suitable outlet to lead off any overflow water. Mounted upon this valve shell is a valve retarding unit, not connected to the air inflow valve, yet free to follow quickly its opening through its full stroke. This valve retarding unit contains a piston equipped with a controller type rolling rubber diaphragm which seals in a quantity of non-freezing valve retarding liquid.

℞ FOR CORROSION...

You don't need a specialist to *recognize* Corrosion. But you do need one to treat it successfully. The skill required to achieve complete corrosion control comes only from the knowledge and experience gained through years of practical application.

Recognition of that fact is one reason more and more people are turning to E.R.P. for assistance on corrosion problems — one reason that thousands of buried or submerged steel structures of all types have been completely protected against corrosion by E.R.P. engineers. Corrosion specialists *for over 17 years*, these men are highly trained and well equipped to help you with *your* corrosion problem. Write for full information today.

COMPLETE CATHODIC PROTECTION SERVICE • DESIGN ENGINEERING MAINTENANCE INSTALLATION EQUIPMENT

ELECTRO RUST-PROOFING CORP. (N. J.)
BELLEVILLE 9, NEW JERSEY
REPRESENTED IN PRINCIPAL CITIES IN THE UNITED STATES

E-27

F. G. Merckel Becomes W & T President

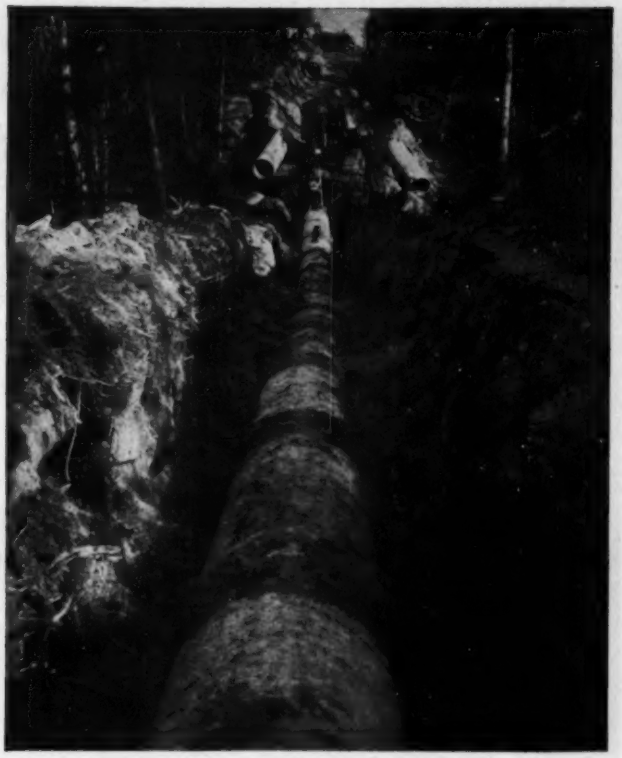
Following the merger of Wallace & Tiernan Co. Inc. and Novadel-Agene Coropration to form Wallace & Tiernan Incorporated, Belleville, N.J., it was announced that F. G. Merckel has been elected President, R. M. Jackson, Executive Vice President and Treasurer and G. D. Peet, Vice President in charge of Product Engineering and Development.

Mr. Merckel, an engineer by training has been with he Wallace & Tiernan group in various executive and sales capacities for nearly thirty-five years. For the past two years he has been president of W. C. Hardesty Co. Inc., a Wallace & Tiernan subsidiary. He is well known throughout all the fields of Wallace & Tiernan and Novadel activities, and brings to his new job a broad experience in management, sales, research and legal matters.

Mr. Jackson has been associated with the organization for over twenty years. He has been Treasurer for the past several years and in that

(*Continued on page* 108A)

Norfolk Prefers Concrete Pressure Pipe



Since 1921, Norfolk, Virginia, has been specifying concrete pressure pipe for its water supply and distribution system. Over 450,000 feet of pipe is now in use. Diameters range from 20″ to 48″.

Still in excellent condition is the 31,700 feet of concrete pressure pipe laid in 1921. There has been no necessity to take this pipeline out of service for any maintenance work; nor has the pipeline suffered from any trouble due to electrolytic action. This pipe is now carrying water at the same high capacity as when it was installed.

If your city wants pipe with an assured high-carrying capacity, decade after decade . . . if long term economy is a necessity . . . then look into the advantages of concrete pressure pipe when you plan your next transmission or distribution lines.

Member companies manufacture concrete pressure pipe in accordance with nationally recognized specifications

Concrete Pressure Pipe

WATER FOR GENERATIONS TO COME

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

(*Continued from page* 106A)

capacity has been active in overall management. His training has been primarily in the financial field but he has also acquired substantial experience in all phases of business management.

Mr. Peet has been with Wallace & Tiernan almost since its inception and is a valued member of the management team. He has been Chief Engineer as well as an officer of subsidiary companies. In those capacities he has made many valuable contributions to company operations both in engineering and management.

Responsible to Mr. Merckel in staff capacities will be: Dr. H. C. Marks, Director of Laboratory Research; David Crampton, Chief Chemical Engineer; J. C. Cornwall, Secretary of the Corporation; and T. T. Quigley, assistant to the President and Operational Analyst.

Moving-Scale Indicator Increases Reading Accuracy of Remote Flow Measurements

404

Fischer & Porter Company has developed a new type of remote indicating device, consisting of a moving strip scale behind a fixed horizontal hairline. Since the strip scale is always read at the same eye level and since the separation between the scale and the hairline is very small, the problem of parallax is virtually eliminated and reading accuracy is greatly increased over other types of indicating scales.

On the current model, the total scale length is 72 in., providing a reading accuracy of better than one part in 2000, when scale divisions are ⅛ in. apart. The 35-mm film scale can be calibrated in any units desired, with a maximum range of 5.5 to 1. The indicator can be located up to 2000 feet from the primary instrument with no loss in accuracy, and at greater distances with special alignment.

The current model is designed for use with the Fischer & Porter 54-OLX flow meter and Ratotronic transmission system.

MECHANICAL JOINT HYDRANT
M H
EASY to INSTALL
Saves Labor
Saves Time
CAST IRON GLAND
CAST IRON BOLT
GASKET
Made-up Mechanical Joint cut away to show its design.
A. W. W. A.
The use of mechanical joints for pipe, valves and hydrants is growing rapidly. The reasons are easy assembly, saving in time and labor cost, and flexibility that maintains a tight, leak-proof joint under conditions such as pipe line expansion, contraction or settling.
M & H Mechanical Joint hydrant is standard compression type. The main valve opens against the pressure. Hydrant valve will remain closed in case hydrant standpipe is broken off in traffic accident. Other features include low friction loss, revolving head, dry top, easy lubrication. Hydrant shoe has two heavy lugs for use in strapping hydrant to dead-end pipe line.
M & H Mechanical Joints are made in accordance with A.S.A. standard specification A21.11, 1952, as approved by American Water Works Association, in which a thick gasket of triangular cross section is compressed by a bolted follower ring.
For complete information, write or wire M & H VALVE AND FITTINGS COMPANY, Anniston, Alabama.
M&H PRODUCTS
FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

R. T. Browning

W. A. Hockett

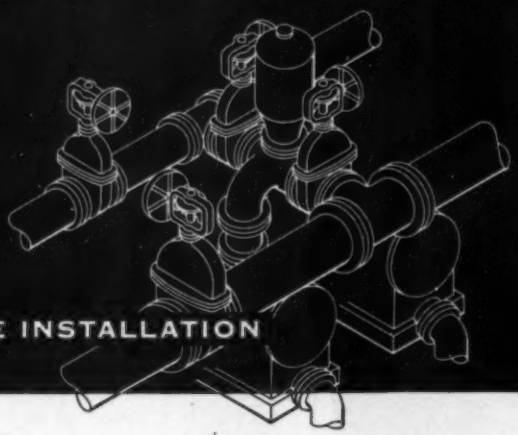
Wallace & Tiernan Incorporated Announces Sales Personnel

Wallace & Tiernan Incorporated, Belleville, N.J., has announced the appointment of the following sales personnel: Vice President in charge of Sales, Robert T. Browning; Director of Sales—W&T Division, William A. Hockett; Manager of Field Sales and Service, Russell C. Clement; Manager of Departmental Sales, Vincent Pisani. Wallace & Tiernan Incorporated is the corporation formed by the merger of Wallace & Tiernan Co. Inc and Novadel-Agene Corporation.

Mr. Browning has had wide experience in both the chemical and equipment lines. He started some twenty-odd years ago as a field salesman and subsequently held positions in the advertising department, the Kooler-Keg Division, Manager of Electro Rust-Proofing and most recently as Director of Sales and Secretary of W. C. Hardesty Co. Inc. a Wallace & Tiernan subsidiary. He is a member of a number of technical and trade associations and is well known in the field.

(*Continued on page* 110A)

These Valves Stay on Job After 50 Years of Water Service



THE INSTALLATION

At the Beaumont City Water Works, Beaumont, Texas, with Crane gear-operated iron body gate valves in main lines in pumping plant.

VALVE SERVICE RATINGS

SUITABILITY: *Always reliable*

FEATURES: *Rugged design in every part*

MAINTENANCE COST: *Routine care only*

SERVICE LIFE: *Still in service—since 1903*

OPERATING RESULTS: *No valve failures*

AVAILABILITY: *Crane Catalog item—Current No. 461*

THE CASE HISTORY

Beaumont taxpayers are still benefiting by the valve quality specified for the Municipal Pumping Station built in 1903. These 14, 16, and 24-inch Crane iron body gate valves remained in their original location until the old plant was converted recently from steam to diesel power. Even then, many were merely cleaned up and put right back in service in the new plant.

For 50 years and more, these Crane valves have given outstanding service at the lowest possible maintenance cost. With but routine care, they remained tight at seat and stem, and always performed with smooth, positive action, despite infrequent operation.

Here's an example of the quality that traditionally sets Crane apart from ordinary valves. It's value like this that has always made Crane the first choice of thrifty buyers in every industry.

THE VALVE

Today's Crane 125-Pound Iron Body Gate Valves with wedge disc are building equally outstanding service records. Highly engineered for durability and dependability at low cost, these valves are now available in the most complete line of patterns and sizes, with a choice of trim for water utilities and other services. Choose to your exact needs from your Crane Catalog, or see your Crane Representative.

THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

(*Continued from page* 108A)

Mr. Hockett began his career with Wallace & Tiernan in the Chicago office over twenty-five years ago and later went to the Indianapolis office. After that he was called to the main office and put in charge of swimming pool sales. Later, he became manager of the Export Division with responsibility for all the Company's foreign operations. He has been an active leader in international trade and technical associations.

Mr. Clement has been associated with the Wallace & Tiernan field organization for over twenty-five years. For a good part of that time he was district manager in the Washington, D.C. office. After that he was made Division Manager at Newark with responsibility for all the northeastern part of the country. His experience particularly fits him to his new duties and his activities with such associations as the American Water Works Association keep him in close touch with technical trends.

Mr. Pisani, with over thiry-five years experience in the Wallace & Tiernan organization, has the background of main office sales operations which will be invaluable to the new management. He has grown up with the company and consequently has acquired both the feel and technical knowledge so necessary to the selling of engineering equipment.

Portable, Low-Cost Threading Machine

405

The Oster Manufacturing Company, Cleveland, Ohio, has introduced a completely new, low-cost power drive for hand pipe tools, the No. 142 "Featherweight Champ."

Weight of the all new drive is only 75 lbs. and one man can move it and use it with ease. Despite its light weight it is a powerful and sturdy machine. Available with either gas or electric power, the "Featherweight Champ" has a threading range of ⅛" to 2".

Seymour Appointed President of Atlas Mineral

Atlas Mineral Products Company, Mertztown, Penna., has announced the appointment of Dr. Raymond B. Seymour as President. Seymour, the originator of furan cements and many of the other products of the Atlas line, joined the firm as Chief Chemist in 1939. Since 1949, he has been Executive Vice President and a member of the Board of Directors.

Seymour is the third president of this 64 year old firm. George L. Wirtz, who has resigned as president, succeeded his father, the late Maximilian F. Wirtz, founder and first president. Joseph A. Snook will continue to serve as Vice President

(*Continued on page* 112A)

The "weak link" in your water distribution system may be your small diameter pipe. Play safe by using McWane 2-inch and 2¼-inch Cast Iron Pipe—which lasts for centuries.

Cast Iron Pipe for larger water mains has long been used, many installations being still in service after 100 to 300 years. Small diameter pipe lines are as long lived as larger mains if you use McWane 2-inch and 2¼-inch Cast Iron Pipe. Small diameter cast iron pipe and fittings are available in 18-foot laying lengths with open bell, precalked bell, mechanical joint or threaded joint, and uncoated, tar coated or cement lined. Write or wire for details. McWANE CAST IRON PIPE COMPANY, Birmingham, Alabama, or PACIFIC STATES CAST IRON PIPE COMPANY, Provo, Utah. (Sales offices in principal cities.)

McWANE PACIFIC — *Lasts for Centuries*

HOW LARGE IS YOUR COMMUNITY?

C-E RAYMOND SEWAGE DISPOSAL SYSTEMS SERVE BOTH LARGE AND SMALL

IN BALTIMORE, FOR EXAMPLE — the new sludge drying plant was placed in service late last year. Serving a population of nearly a million people, the new installation is designed to dry the sludge from 125 million gallons of sewage a day.

An important part of the huge Back River Treatment Works, the plant was designed by Whitman, Requardt & Associates, Baltimore.

Three C-E Raymond Flash Drying Systems dry the digested filtered sludge, to produce high quality fertilizer at the rate of 15,000 to 27,000 tons a year.

Many other large communities have discovered the practical answer to sludge disposal problems in C-E Raymond Systems. Chicago . . . Los Angeles . . . San Francisco . . . Washington — these large cities alone have in operation or under construction C-E Raymond equipment to serve an equivalent population greater than 11,000,000.

The popularity of C-E Raymond Systems does not stop with larger cities, however. In communities with equivalent populations as low as 6,000, this equipment has been proved in years of actual service. As a matter of fact, the aggregate capacity of C-E Raymond Systems installed, under construction or on order is *nearly 50% more than the total of all other heat methods of sludge disposal combined.*

So, whether your community is large or small — look to the leader for the most efficient end to your sludge disposal problems. For details, just get in touch with the C-E Raymond office nearest you.

B-717

COMBUSTION ENGINEERING, INC.

RAYMOND DIVISION: 1315 North Branch Street, Chicago 22, Illinois

Western Office: 510 W. Sixth Street, Los Angeles 14, Cal. • Eastern Office: 200 Madison Avenue, New York 16, N. Y.

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

(*Continued from page* 110A)

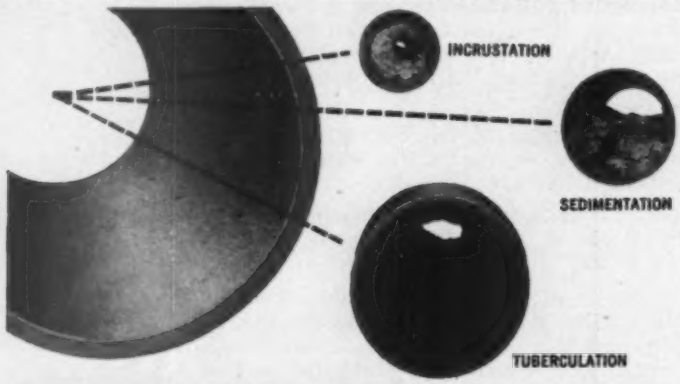
in Charge of Sales and Enginering. The Board of Directors consist of Wirtz, Seymour, Snook and Daniel Lowenthal, partner in the firm of Fox, Rothschild, O'Brien and Frankel, Attorneys, Philadelphia, Pa.

Control Panel Board "Package"

406

J. P. O'Donnell Corp., Instrument Division, New York, N. Y., is now offering a 10-service automatic control panel board "package" for the process and allied industries. Included in the arrangement are standard, semi-graphic, and graphic control boards.

The instrumentation "package" consists of the following: Instrumentation planning by the corporation's instrument engineers in collaboration with the corporation's and/or the client's process design engineers; specification and purchase of the instruments; design of the control panel board; fabrication, including mounting, piping and wiring of instruments; field installation of locally mounted transmitters and controllers, and adjustment of control valves and positioners; field installation of instrument air-supply and of instrument piping to all locally mounted controllers, relays, and control valves; field installation of electrical work necessary for the operation of instruments; field checking of operation of all instruments and associated equipment; field instruction of operating personnel in instrument operation and maintenance; and instrument adjustment during plant start-up.



NATIONAL KNOW-HOW PAYS!

National knows how to work quickly reducing supplementary labor costs and service interruptions.

National knows how to clean the difficult jobs, including hard incrustations, unusual obstructions and pipes of unusually large or small diameter.

National knows how to clean long runs with a minimum number of pipe entries.

National knows how to avoid trouble, such as can occur from improper provision for drainage of flush water from large mains or from the use of excessive pressures.

National knows how to clean so thoroughly that restoration of 95% of the original pipe capacity is guaranteed.

National Know-How comes from over 40 years of experience cleaning water mains.

Write or call today for information and prices.

NATIONAL WATER MAIN CLEANING COMPANY
50 Church Street • New York, N.Y.

ATLANTA, GA; 333 Candler Building • BERKELEY, CALIF; 905 Grayson Street • DECATUR, GA; P.O. Box 385 • BOSTON, MASS; 115 Peterboro Street • CHICAGO; 122 So. Michigan Avenue • ERIE, PA; 439 E. 6th Street • FLANDREAU, S.D; 315 N. Crescent Street • KANSAS CITY, MO; 406 Merchandise Mart and 2201 Grand Avenue • LITTLE FALLS, N.J; BOX 91 • LOS ANGELES; 5075 Santa Fe Avenue • MINNEAPOLIS, MINN; 200 Lumber Exchange Building • RICHMOND, VA; 210 E. Franklin Street • SALT LAKE CITY; 149-151 W. Second South Street • SIGNAL MOUNTAIN, TENNESSEE; 204 Slayton Street • MONTREAL, CANADA; 2032 Union Avenue • WINNIPEG, CANADA; 576 Wall Street • HAVANA, CUBA; Lawrence H. Daniels, P.O. Box 531 • SAN JUAN, PUERTO RICO; Luis F. Caratini, Apartado 2184.

34

K. B. Gerrish

S. H. Wilson

Gerrish and Wilson Named To Continental Can's New Plastic Pipe Division

Continental Can Company, New York, N.Y., has announced that Kenneth B. Gerrish has been named director of sales and Sidney H. Wilson, sales manager, for the company's new Mills Plastic Pipe Division, located at Continental's head office in New York.

These appointments follow Continental's acquisition of Elmer E. Mills Plastics, Inc., the organization which handled pipe sales for the former Elmer E. Mills Corporation. Mr. Gerrish was president of that organization, and Mr. Wilson, vice president and sales manager.

Mr. Gerrish's new position with Continental in no way affects his position as president of Manufacturer's Promotional Service, Inc., another New York sales organization.

New Wellpoint Design

407

Foundation Equipment Corporation, Long Island City, New York, have developed a wellpoint of new design. It will be marketed under the name, "Freeflow". This new wellpoint is an original design with patented features developed through years of research and field experience. Manufacturer claims that field tests have demonstrated to their full satisfaction that the Freeflow Wellpoint is more dependable, has higher capacity, and

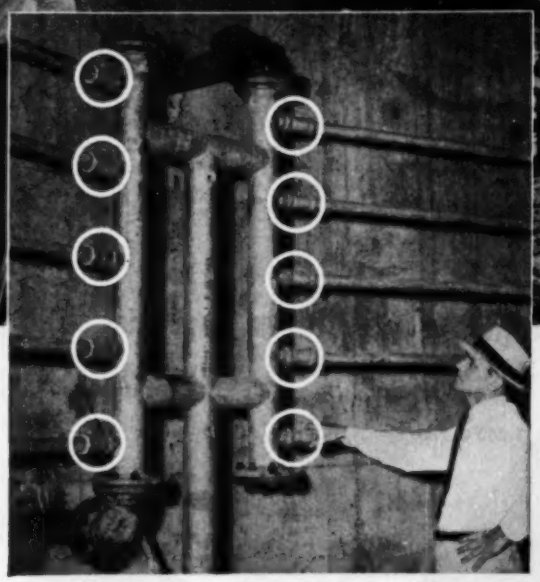
(*Continued on page* 120A)

Canton sanitary engineers find the easiest way to solve difficult piping problems is also the most dependable . . . with Dresser Couplings

One of the construction problems at Canton, Ohio's Sewage Treatment Plant was installation of a special welded tee on the effluent line between grid house and primary tanks.

The use of 54" Style 38 Dresser Couplings made the installation relatively simple. Workmen, with a minimum of skill and heavy equipment, quickly made permanently tight Dresser joints.

Recognizing the many applications for versatile Dresser Couplings throughout the plant, Canton engineers greatly simplified tough, close-quarter piping installations.



Hot water heating coils completely encircle the interior walls of six large digester tanks in the Canton Plant. 450 Dresser Style 65 Compression Couplings were used to absorb expansion-contraction of piping and to simplify close-wall installation.

Write today for more information on how Dresser Couplings can save *you* time and money on water, sewage and industrial waste projects.

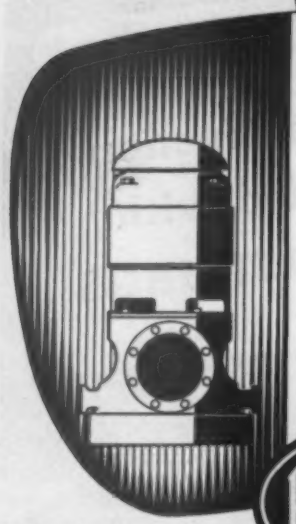
DRESSER® COUPLINGS

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: Toronto, Ont.

PEERLESS

Vertical

PUMPS



Deep Well and Close Coupled Pumps for Water Supply, Cooling Tower Service, Flood Control, Drainage, Sewage Disposal and Process Services.

Write for descriptive Bulletin on type you require.

PEERLESS PUMPS

PEERLESS PUMP DIVISION

Food Machinery and Chemical Corp.

Factories: Los Angeles, Calif.; Indianapolis, Ind.

Offices: New York; Chicago; St. Louis; Atlanta; Phoenix; Dallas, Plainview and Lubbock, Texas; Fresno; Los Angeles; Albuquerque.

PEERLESS BUILDS DEPENDABLE PUMPS

(*Continued from page* 104A)

Oct. 27-29—Baltimore, Md. *(Hotel not selected)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl Lauter, 6955 33rd St., Washington 5, D.C.

Nov. 3-5—Richmond, Va. *(Jefferson Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanagh, 915 Colonial-American Bank Bldg., Roanoke 11, Va.

Nov. 4-6—Atlantic City, N.J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N.J.

Nov. 8-9—Huntington, W.Va. *(Hotel Prichard)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston 5, W.Va.

Nov. 7-10—St. Petersburg, Fla. *(Soreno Hotel)*
FLORIDA SECTION A.W.W.A. Sec'y, Wm. W. Aultman, Box 316, Coconut Grove Sta., Miami 33, Fla.

Nov. 8-10—Asheville, N.C. *(George Vanderbilt Hotel)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, E. C. Hubbard, P.O. Box 2091, Raleigh, N.C.

Nov. 9-10—Colorado Springs, Colo. *(Hotel not selected)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, Geo. J. Turre, Box 600, Denver, Colo.

Nov. 11-12—McCook, Neb. *(Keystone Hotel)*
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Paul W. Mousel, 602 West B Street, McCook, Neb.

Nov. 17-19—Allerton Park, Ill. *(Univ. of Illinois)*
ILLINOIS WATER WORKS MANAGEMENT SHORT COURSE. Director, Dr. T. E. Larson, State Water Survey, Urbana, Ill.

Nov. 28-Dec. 3—New York, N.Y. *(Statler Hotel)*
AMERICAN SOCIETY OF MECHANICAL ENGINEERS. (Annual Meeting). Sec'y, C. E. Davies, 29 West 33rd St., New York, N.Y.

Dec. 8—Winthrop, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Faithful Performance on Important Jobs

— such as water supply, brine circulation, booster service, white water and overflow, hot well, makeup water, etc., etc.

Capacities to 1,200 G.P.M.

Heads to 460 Ft.

PUMPS "by Aurora"

For Every Purpose

TYPE-AD Aurora Horizontally Split Case, Back-to-Back Impellers, Two Stage Centrifugal Pump. Particularly suited to clear water and low viscosity liquids not containing solids. Write for BULLETIN 106

APCO TURBINE-TYPE PUMPS are unbeatable on low capacity, high head duties.

Capacities to 150 G.P.M. Heads to 500 Ft.

AURORA CENTRIFUGAL PUMPS are available in many types and sizes —all noted for their streamline coordination between impellers and shells.

Write for CONDENSED CATALOG "M"

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS

AURORA PUMP COMPANY

DIVISION OF THE NEW YORK AIR BRAKE COMPANY

68 Loucks St., Aurora, Illinois

NO "CRYSTAL BALL" NEEDED

Detectron "505"

PIPE DETECTOR

takes all guesswork out of Pipe Detection

◀ DETECTS, TRACES and CENTERS PIPE, CABLE, ETC.

◀ ESTIMATES EXACT DEPTH

◀ SEPARATES PARALLEL PIPE, CABLE and CONDUIT

A crystal ball might be one way to locate buried pipe or cable at an excavation site. But . . . a *better, safer* and *more efficient* way is to use the new, improved Detectron "505" that accurately pinpoints the exact length, depth and location. *Stop guessing —and be sure!*

Send today for FREE Catalog No. 57

THE Detectron CORPORATION

5420 VINELAND AVE., NO. HOLLYWOOD, CALIF.

"Every individual connected with water purification or sewage works should subscribe to this publication. I have introduced it to a host of friends in this field"

Testimonials such as this from subscribers to WATER & SEWAGE WORKS really tell the story. The man who reads and uses the magazine as an aid in his work knows how much it will benefit other workers in the field.

The great REFERENCE & DATA issue alone is worth more than the yearly subscription rate. In it you will find formulae, charts and illustrations covering information not obtainable in any other one source.

Supply of 1953 REFERENCE & DATA number is limited. If you are not a subscriber send your order today!

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You may enter my order for 1 yr. @ $2.00 ☐
☐ Include R&D issue 2 yrs. @ $3.00 ☐
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Send bill to.....
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(Add $1.00 per year for foreign postage)

- *If you are interested in the water field only you get all the authoritative data on this subject.*
- *If you are interested in sewage problems only you are kept fully informed and given much help in this field.*
- *If you are interested in both subjects you get all the information in this one monthly magazine.*

how much does it cost to stand pat?

It isn't often that a new development comes along that affects chlorine handling—in fact, not in the past 35 years has there been news as important as this to you and your community.

You may feel it costs you nothing to let new developments in chlorine handling go by the board. *But it costs your community plenty*—in money, in better chlorination and in better, *safer* handling methods.

Ratochlor units in F & P Hatboro plant awaiting inspection and test *with chlorine* under actual operating conditions.

AN ENTIRELY NEW WAY TO CHLORINATE

Not in 35 years has such a completely new, easy operating, dependable and economical chlorinator been made. There are many reasons why this has been so. One of the most important reasons is that suitable materials that could remain inert to corrosion *were not yet invented.* As a result of wartime needs, many new materials are available now that were not in the laboratory stages even ten years ago.

The most positive way to regulate and control chlorine is the diaphragm regulator principle. But until these corrosion resistant materials were invented, a regulator could not be made that lasted against corrosion. The regulator principle is successfully used in the new Fischer & Porter Ratochlor unit, along with such new products as Uscolite, manufactured by U.S. Rubber Co., Kel-F, Hastelloy, Teflon, and such timeless materials as silver and tantalum.

Old fashioned, out-of-date chlorine dispensing equipment uses vulnerable water seals, whereas in the Ratochlor unit, chlorine is always handled in fully enclosed, tightly sealed, corrosion resistant pipes and components. Chlorine losses from old fashioned design lead to increased corrosion, thus to excessive operating costs. Constant service calls add to costs, repeated maintenance charges mean that you still have an old fashioned unit with most original parts replaced. Such costs are cut to the bone with the new Ratochlor chlorinator.

The Fischer & Porter chlorinator was completely engineered to take advantage of all new developments, was then exhaustively tested in the field for five years. Now you can be sure of the finest in chlorination equipment. Even the outside cabinet is so new, of corrosion resistant *fibre-glass,* that it never needs painting, is resilient to withstand blows and vibrations. The Ratochlor unit is superior in every way. It is low in first cost, costs little to maintain.

You owe it to yourself and your community to *know* about this dependable, safe, less costly way of handling chlorine. Complete facts, fully illustrated, will be sent to you if you will request them right now.

EVERY RATOCHLOR IS BACKED WITH AN IRON-CLAD GUARANTEE

You can't go wrong in replacing old fashioned equipment NOW with the F&P Ratochlor chlorinator. Here's why. Fischer & Porter is a major company, leaders in flow control instrumentation. Hundreds of tons of live chlorine are handled daily by F&P Flowrator* meters in the chemical industry. The Ratochlor unit is so superior to any ever offered, so simple in design and control that it is almost entirely free of costly, repeat service calls. Equipment now in daily use in many communities shows that yearly maintenance costs are a fraction of older units.

Fischer & Porter stands four-square back of *every* Ratochlor unit. Before you agree to buy, F & P will install a Ratochlor chlorinator for a thirty day test period. During this time, you can subject this new unit to any kind of test you can make. *You must be fully satisfied.*

And the day you install your first Ratochlor unit, is the first day of a full year during which you must continue to be fully satisfied with it. Even at the end of one year, if you're not fully satisfied, the Ratochlor unit will be taken out and the full cost—every cent of it—will be refunded. You can't lose with the Ratochlor chlorinator.

complete process instrumentation

FISCHER & PORTER CO.

*T.M., F&P CO.

3920 Fischer Road, Hatboro, Penn.

Company owned sales and service branches strategically located throughout the world.

8201

No words needed...

Before ever he speaks a word, he asks your love.
In it begins the security he will need forever.

The whimper when he's hungry, the sigh of peace when he's fed and warm, the cuddle of his sleepy body—all these tell a need that never ends.
The need that none of us outgrows: to be safe and secure in body and heart as long as we live.

The security of our homes is a universal dream. That each of us is free to make secure the lives of those we love, is our peculiar privilege.

As we take care of our own, we also take care of America. Out of the security of each home rises the security of our country.

Your security and your country's begin in *your* home.

Saving for security is easy! Read every word—now! If you've tried to save and failed, chances are it was because you didn't have a *plan*. Well, here's a savings system that really works—the Payroll Savings Plan for investing in United States Savings Bonds.

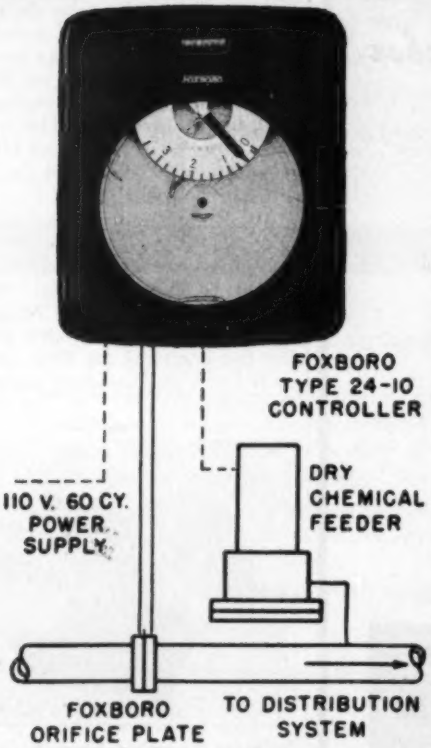
This is all you do. Go to your company's pay office, choose the amount you want to save—a couple of dollars a payday, or as much as you wish. That money will be set aside for you before you even draw your pay. And automatically invested in Series E Savings Bonds which are turned over to you.

If you can save only $3.75 a week on the Plan, in 9 years and 8 months you will have $2,137.30. If you can save as much as $18.75 a week, 9 years and 8 months will bring you $10,700!

For your sake, and your family's, too, how about signing up today?

WATER & SEWAGE WORKS

give young teeth full benefits of fluoridation...



Foxboro automatic control assures that fluoride is fed into water in exact proportion to rate of flow . . . prevents either over or under dosage.

BY EQUIPPING FLUORIDE FEEDERS WITH FOXBORO CONTROL

You can provide the maximum benefits of fluoridation with complete safety for your community, by adding automatic Foxboro Control to your fluoride feeders. It's the sure way to prevent over- or under-treatment.

The Foxboro Type 24-10 Controller, combined with either a dry or solution feeder, accurately controls the addition of fluoride in the distribution system, and keeps continuous quantitative records of the process.

Get all the facts on this fluoridation control. Write for application Data Sheet 831-18.

THE FOXBORO COMPANY, 262 NORFOLK ST., FOXBORO, MASS., U. S. A.

FOXBORO RECORDING · CONTROLLING · INDICATING INSTRUMENTS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

(Continued from page 112A)

gives longer service without maintenance. The following are its exclusive features: No rusting; Free flow —Higher capacity; No sand or silt pockets; and less maintenance.

Portable Liquid Filter for Radioactive Waste Disposal

408

Atomic Energy Waste Disposal Service, Oakland, Calif., has announced that in addition to their radioactive waste disposal service they have developed a Nuclear Liquid Filter.

The filter includes the special filter material in cartridge form, built-in shielding and effluent hold-up tank, and an indicator section to show whether the effluent is basic or acidic.

The volume of radioactive liquid material may be from a few gallons up to many thousands with a single cartridge, depending upon the concentration of the total liquid.

This Nuclear Liquid Filter is adaptable for use in laboratories in government facilities, hospitals and clinics, industry, research institutions, colleges and universities where radioisotopes are used.

Gate Operation

Waste of Time plus Hard Labor

Can you honestly continue this outmoded operation?

Does it make sense when you can have a junior model operator delivered & ready for mounting on any truck you have, for $700.

Delivered in 2 weeks.

Installed in a few hours.

BULLETIN SHOWS 200 SATISFIED WATER WORKS

TRUCK ON MAINTENANCE DUTY

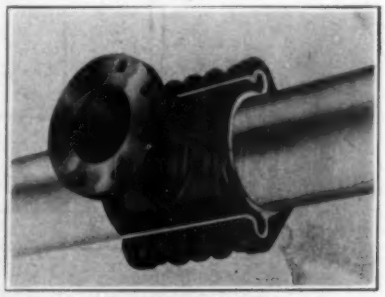
PAYNE DEAN & CO. CLINTON, CONN.

American Vitrified Names Miller President, and Brown V.P. and Gen. Sales Mgr.

American Vitrified Products Company, Cleveland, Ohio, has announced the election of Mr. E. L. Miller as President. James G. Robertson, the company's President since 1933 was named Chairman of the Board. Mr. J. L. Brown, who has been Vice President in charge of Sales was named Vice President and General Sales Manager.

Mr. Miller joined American Vitrified in 1924 in the traffic department. He moved into the sales department and in 1942 was named General Sales Manager. In 1946 he was appointed Vice President and General Manager and a Director of the company. Mr. Miller is a Director of The National Clay Pipe Association, and serves on committees of the American Society of Testing Materials.

Mr. Brown joined American Vitrified in 1935 as a salesman in the Columbus office. In 1945 he was promoted to Western Sales Manager with headquarters in Chicago. He was named General Sales Manager for the company in 1946 and promoted to Vice President in charge of Sales in 1951.



Boltless Tapping Sleeve For Cement-Asbestos Pipe

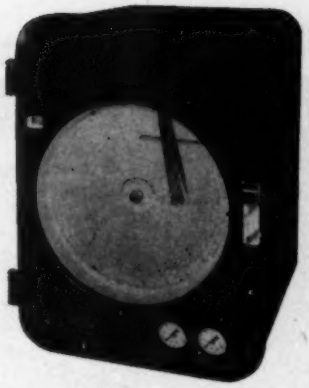
409

The Corey Manufacturing Company, Los Angeles, Calif., has developed a new Boltless Tapping Sleeve for Cement-Asbestos Pipe. Designed to eliminate the parts generally affected by corrosion and constructed of high quality gray cast-iron, the new Boltless Tapping

(Continued on page 122A)

for
Reliable Measurement
of low differentials

HAGAN



RING BALANCE METERS

Where flow measurements *must* be made with a low full scale differential, the logical choice is the Hagan Ring Balance Meter. This versatile meter, with no external sealing chambers, is equally useful for flow measurements at low differential or high differential, at high or low pressures.

Consider these advantages of the Hagan Ring Balance Meter

Interchangeable sensing elements, in a complete series, are available for measuring full scale differentials from 1″ to 420″ WC, at static pressure up to 3,000 psig.

The ring assembly is selected for each installation to assure ample power for accurate meter operation at all flows.

The differential range of any ring is adjustable over a 7 to 1 ratio.

The level of sealing fluid in the ring is not critical, the only requirement being sufficient depth to seal against maximum differential.

Calibration, using dead weights, takes only a few minutes. It is not necessary to disconnect the meter from the line.

Automatic compensation for such variables as temperature, pressure or fluid density is a standard attachment.

Pneumatic or electric signal transmission is available for remote recording or automatic control.

The Hagan Ring Balance Meter is the most versatile design available for flow measurements with any source of differential—orifice plate, venturi tube, pitot tube, weir or flume.

We will be glad to suggest the metering equipment best suited for improving existing facilities, or for extensions and new construction.

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION

Hagan Building • Pittsburgh 30, Pennsylvania

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems
Control Systems for Automotive and Aeronautical Testing Facilities

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

THOROSEAL *Restored* this Filtration Plant

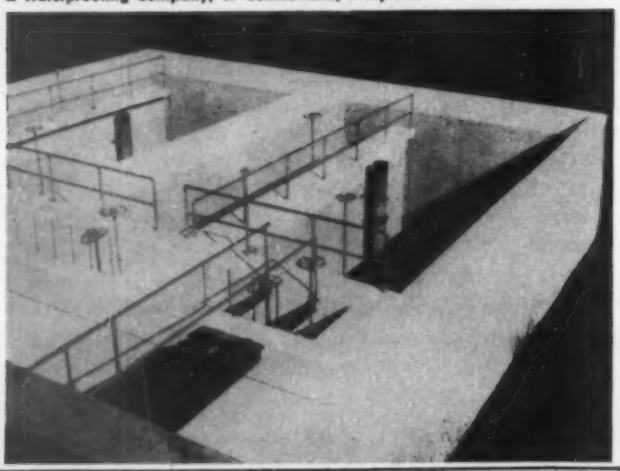
BEFORE

Example of complete break-down of masonry, due to penetration of water into body of concrete and action of frost in damp masonry.

It is amazing how THORO System products will correct a condition, such as shown in photograph. Concrete was sandblasted to remove all disintegrated material to sound concrete surface and reinforcing rods. Patching was done with THORITE Patching Mortar, bringing blistered areas to true and even lines, followed by two applications of WHITE THOROSEAL for protection.

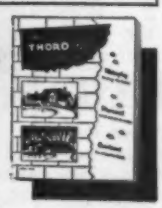
AFTER

At minimum cost, almost ⅓ the cost of other methods, concrete restoration, patching and surface protection was completed with THORO System products on Filtration Plant in Keyser, West Virginia. Contractor: Standard Construction & Waterproofing Company, of Cumberland, Maryland.



WATERPLUG	THOROSEAL	QUICKSEAL
To Stop Leaks	To Seal Surface	For Beautiful Finish

Our 20-page Brochure describes, in detail, how The THORO System products can benefit you in your construction plan. Send for brochure today, which shows methods of application and how to use the material.



Standard Dry Wall Products

Box X, NEW EAGLE, PENNA.

(*Continued from page* 120A)

Sleeve will actually outlast the pipe on which it is installed.

Economy in installation and maintenance using this new type tapping sleeve is offered through a number of outstanding features. Elimination of the usual caulking process and the simplicity of installation makes it possible for even unskilled workmen to make a new installation or a tapping sleeve replacement in just a few minutes. Without the caulking process, less working area is needed, hence less excavation is required. The mounting method is such that it is possible to work at close quarters with other pipe and conduit in comparative comfort. Water-tested in excess of 1700 lbs. psi, the new sleeve offers complete leak-proof performance. Sleeves are furnished in a wide range of tapped and flanged outlets for use in water and gas service.

M. C. Bickert

Marlow Assigns New Field Engineer

Marlow Pumps, Ridgewood, New Jersey, has announced the appointment of Maurice C. Bickert as District Engineer. He will cover the four state Mid-Atlantic district consisting of Southern Pennsylvania, New Jersey, Delaware, and Maryland from headquarters in Ridgewood.

Mr. Bickert, who recently completed the Marlow Training Course, came to the company from Wallace & Tiernan where he was a Sales Engineer. Previous business experience was gained with the Permutit Company. Mr. Bickert is a graduate of Stevens and served in the U.S. Navy.

New Rust Preventive

410

Octagon Process Inc., Staten Island, New York, has developed No-Rust-Oil, that is said to dry to a beautiful, hard, glossy and soil-proof finish that stops rust for a year.

No-Rust-Oil is a light oil, that dries in 15 minutes and can be applied to any metal by wipe-on, brush-on or sprayed. It provides protection

(*Continued on page* 124A)

STEEL PIPE solves headroom problem as Newark modernizes vital water control station

Back in 1800, the community of Newark, New Jersey, used a water supply system of hollow logs. Today, over 50 miles of huge steel primary feed lines rush upstate water to more than half a million people.

Focal point of this system, which includes nine major reservoirs and over 150 square miles of watershed, is the Bloomfield Avenue Tower, terminal for five of the six main feeder lines. Modernization recently called for replacement at the tower of 35 small double-gated valves with 8 new cone-type valves and requisite piping to handle the system's high pressure flow.

Low headroom and critical location made pipe selection particularly vital. The problem was solved with Alco Electric Welded Steel Pipe—1650 ft of 48-in., 450 ft of 36-in. and 30 ft of 60-in. pipe. Through it will surge over 85 million gallons of water per day.

Furnished in diameters from 20 to 120 in. and lengths to 40 ft, Alco Electric Welded Steel Pipe is specified the country over for its engineered strength, efficiency, economy and long life.

So whether your installation is large or small, special or standard, have a talk with your Alco Products sales representative. He will give you complete technical data—plus expert help with your own special problems.

CITY OF NEWARK uses strong, efficient Alco Electric Welded Steel Pipe in 36, 48 and 60-in. diameters and special sections (shown above) at vital Bloomfield Tower control station.

COMPLETE, modern facilities and many years of experience enable Alco to fabricate top quality low cost pipe for almost any installation, standard or special.

Remember these Key features of Alco Steel Pipe

STRONG: Unaffected by vibration. Maximum resistance to shock, and to overloading due to earth movement and washouts.

EFFICIENT: Positively watertight. Minimum number of field joints. Smooth surfaces for highest rate of flow.

ECONOMICAL: Low first cost. Long lengths, light weight for easy installation.

DURABLE: Life in water supply installations estimated conservatively at 75 to 100 years.

ALCO PRODUCTS

AMERICAN LOCOMOTIVE COMPANY

DUNKIRK, N. Y.

Sales Offices: New York, Chicago, Dunkirk, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

In water and Sewage Treatment Plants....

HOMESTEAD *Lubricated* **PLUG VALVES**

PROVIDE
the lowest cost-per-year fluid control
... of any Valve within Their Service Range

BECAUSE

- **They are pressure sealed and chemical sealed**
- **They automatically adjust for wear**
- **Need less lubricant**
- **Low first cost; low upkeep**

Extra long leakless service and low operating costs are assured by Homestead's exclusive *self-sealing, wedge-acting,* two-piece plug. *Under line pressure,* it *automatically adjusts for wear* as wear occurs, thereby keeping the closely fitted seating surfaces in constant contact to maintain a drop-tight seal. *Full lubricant seal* around ports and a triple head seal give additional assurance of long, trouble-free service.

Next time you order valves, specify HOMESTEAD *Self-Seald, Lubricated* PLUG VALVES and prove them to your own satisfaction. We can furnish them in semi-steel or cast steel; 100% port area or Venturi; 1½ in. to 14 in.; for steam working pressures to 150 lbs.; air-water-gas to 200 lbs.

Also available in one-piece plug design.

For full information, MAIL THE COUPON TODAY.

Please send me VALVE REFERENCE BOOK No. 39-5 on Homestead Self-Seald Lubricated Plug Valves.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

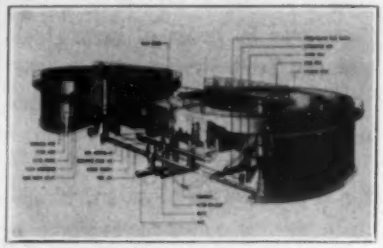
CITY _____ STATE _____

HOMESTEAD VALVE MANUFACTURING COMPANY
Serving Since 1892

P. O. BOX 42 CORAOPOLIS, PA.

(*Continued from page* 122A)

against rust and corrosion for iron, steel, aluminum, brass, bronze and copper. The transparent glossy coat does not rub off and if desired, metals treated with No-Rust-Oil may be painted right over the coating. The oil may be removed with any petroleum solvent such as kerosene.



Water Purification Unit Combines Pre-Treatment and Filtration in Single, Compact Installation

411

The Dorr Company, Stamford, Conn. announces the Dorrco Aldrich PeriFilter System for the pre-treatment and filtration of municipal and industrial water supplies in a single unit. Color, hardness, iron, manganese, or turbidity is removed from the raw water in a mechanical pre-treatment unit and residual turbidity and bacteria in an annular rapid sand filter.

For normal applications the pre-treatment mechanism in the System will be a Dorrco Hydro-Treator, although specific local purification problems may indicate the desirability of using either a Dorrco Clariflocculator or Dorr Clarifier. The annular rapid sand filter differs from conventional rectangular filters only in its peripheral placement with reference to the pre-treatment mechanism. Raw water, filter effluent, sludge, backwash water, and backwash drain flows are controlled by manual, hydraulic, or motor operated valves sheltered in a valve house adjacent to the purification unit. One valve house may serve as many as four operating units.

In operation, raw water is fed directly to the pre-treatment units, with coagulating chemicals either added by means of a head box or introduced directly into the sludge blanket. Settled solids in the pre-treatment compartment are raked by positive means to the central cone and discharged, while clarified water overflows the weir to the filter. Both compartments have an identical water level which permits a gentle transfer across a submerged weir

(*Continued on page* 126A)

48 miles of CONCRETE PIPE assure adequate water supply for Savannah River Project

Producing materials for both A and H bombs at the Savannah River Plant in South Carolina requires enormous quantities of water. This water, from the Savannah River, is carried in concrete pipe lines to two pump houses, then distributed by other concrete pipe through the 315 square-mile plant site. From the pump houses the shortest line is 29,834 ft., the longest 62,419 ft. The system required 48 miles of concrete pipe.

Extremely difficult engineering problems were encountered in building this project because of the high water table in the entire area. Complete wellpoint systems had to be installed on every line as shown in the photograph. Many lines were laid in swamps and under creeks and railroads.

Whether the water line you plan is to be long or short, concrete pipe offers you the rugged strength, the long life and the economy necessary for satisfactory service. Its tight joints and dense structure prevent leakage and infiltration.

Because durable concrete pipe is not subject to damaging internal corrosion, it will maintain constant hydraulic efficiency. And it delivers long years of dependable, ***low-annual-cost*** service.

CONCRETE PIPE USED IN SAVANNAH RIVER PROJECT

48"	410 ft.	66"	65,225 ft.
54"	5,250 ft.	72"	23,178 ft.
60"	28,493 ft.	78"	30,472 ft.
		84"	100,529 ft.

PORTLAND CEMENT ASSOCIATION

33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

there should be
EDDY HYDRANTS
in your future installation plans because:

- They are mechanically *right* and simple in design—built to highest standards of craftsmanship—for decades of dependable operation with minimum maintenance.
- Easily serviced by one man, without special tools or heavy rigs.
- Large waterways—open smoothly *with* the pressure and close without water hammer.
- Drip action positively drains standpipe, safeguarding against freeze-ups.
- Available with all types of connections.
- 104 years' successful operation assures availability of repair parts.
- Meet all A.W.W.A. specifications.

Send today for full information on the complete line of Eddy Valves and Hydrants. No obligation.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons
WATERFORD, NEW YORK

(*Continued from page* 124A)

and minimized the disintegration of minute floc structure formed during pre-treatment, Residual turbidity and bacteria are then removed by the sand filter, and the filtered effluent flows to a discharge pipe and is pumped to storage. Length of filter runs will be comparable to those obtained with conventional filters.

The manufacturer claims the major advantages of the system stem from its ability to perform both pre-treatment and filtration in a single, compact unit. Initial installed costs may be reduced as much as 40% as compared with conventional plants, and operating costs will normally be lower because of decreased head losses through the plant and simplified operation. The depth of water above the sand during operation eliminates air binding in the filter and centralized control may be provided by panel housed instrumentation. The unit construction feature permits unusual design flexibility and rapid expansion of existing plants.

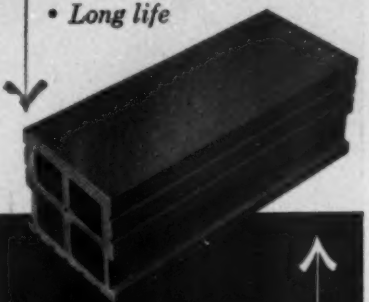
New Shaft Mounted Drive

412

The Falk Corporation of Milwaukee, Wisconsin, has announced a new speed reducer which mounts directly on the shaft to be driven and requires no floor space other than that needed for the motor and tie rod connection.

Easily adapted to fit various driven shaft diameters, this drive offers comparatively high ratios of speed reduction in very limited space. A choice of single or double reduction unit makes possible the selection of almost any output speed between 420 and 14 rpm, merely by changing sheave sizes within allowable limits. Six sizes to cover the range from ½ to 30 hp. All-steel construction, highly efficient helical gearing, positive lubrication.

- *Permanence*
- *No tuberculation*
- *Equal distribution*
- *Uniform filtration*
- *Low loss of head*
- *Acid, alkali-resistant*
- *Long life*



You get ALL these advantages with
LEOPOLD
Glazed Fire Clay
TILE FILTER BOTTOMS

Today, in more than 250 plants with a daily capacity of over 1¼ billion gallons, Leopold Duplex Filter Bottoms are providing dependable, economical service with minimum maintenance.

Made of highest quality de-aired fire clay—vitrified and salt glazed, the Leopold Filter Bottom requires only a shallow depth of small sized, inexpensive filter gravel to support the filtering medium. Further, the laterals and distributing blocks are all combined in one strong permanent unit that will last indefinitely.

Adaptable to any rectangular filter unit, the Leopold Glazed Tile Filter Bottom is designed to successfully meet all underdrain requirements.

Each Leopold filter block is about 2 sq. ft. in area—weighs approximately 100 pounds.

Complete Water Purification and Sewage Plant Equipment . . .

- DRY CHEMICAL FEEDERS
- FILTER OPERATING TABLES
- MIXING EQUIPMENT

Want more details? Write us today.

F. B. Leopold Co., Inc.
2413 W. Carson Street
Pittsburgh 4, Pa.

Hamill Appointed Sales Representative for A.C.F.

American Car and Foundry Company, New York, N.Y., has announced that Walter L. Hamill has been appointed as sales representative for ACF valves in the northeastern territory comprising New England, New York and New Jersey.

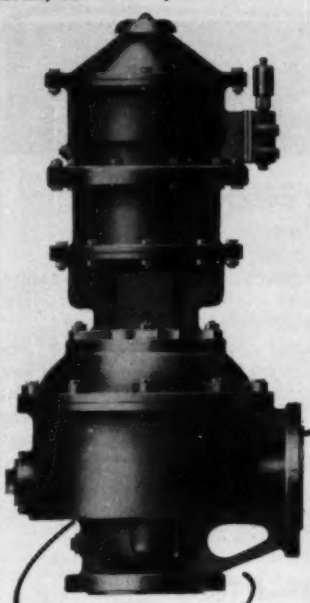
Prior to coming to ACF, Mr. Hamill was associated with Homelite Corp. of Port Chester, N.Y.; and with Henry Gassner, Inc. He attended Rhode Island State University and is a Lieutenant Colonel in the U.S. Army Reserve Corps.

Wanich Joins Fischer & Porter

Fischer & Porter Company, Hatboro, Pa., has announced that Mr. Glenn C. Wanich has joined the field force of its Chlorinator Division. He will represent the company in Eastern Pennsylvania and Western New Jersey with headquarters at Bala, Pennsylvania.

Mr. Wanich has spent the past few years in the water and sewage treatment department of the City of Bethlehem, Pennsylvania. Prior to that time he had worked several years with the Western Electric Company and with Best Foods, Inc. Mr. Wanich is a graduate of Lehigh University holding a B.S. in Chemical Engineering and an M.S. in Chemistry. He is a member of the Pennsylvania Sewage and Industrial Wastes Association.

Kindness is one commodity of which you should spend more than you earn.



New Simplex Type CCAV Valve. Combination controlled-closing and vacuum-breaking valve.

ONE 4-INCH CONNECTION to your main pipe line...

PREVENTS { **surge rupture vacuum collapse**

Why take chances? No matter what the safety factor, surge and hammer can play some dirty tricks . . . rupture lines, blow out packing, fracture valves. And if the line breaks or is drained rapidly, it can collapse from vacuum.

Simplex Type CCAV is a new combination! A controlled-closing and vacuum-breaking valve to protect your lines against these dangers. It's easily installed, moderately priced, positive-acting.

When lines are being filled, Type CCAV Valve vents air to prevent binding, controls transfer time to prevent surge damage. Timing can be quickly set from a few seconds up to well over ten minutes—as dictated by site requirements. If hammer is excessive, Type CCAV automatically discharges water . . . extra protection for costly lines and fittings.

When lines are subject to collapse from rapid draining or line breaks, the Simplex CCAV acts quickly . . . breaks the vacuum for maximum safety.

WRITE FOR FREE BROCHURE

SIMPLEX VALVE & METER COMPANY
6743 UPLAND STREET, PHILADELPHIA 42, PA.

SIMPLEX®

VALVE AND METER COMPANY

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

WILKINSON LINE LOCATOR

The original—the pace setter

Built to QUALITY

strict standards

Choice of discriminating buyers everywhere

Buy Satisfaction—not 'first cost'

Get the facts first

Locates all parts of your underground system

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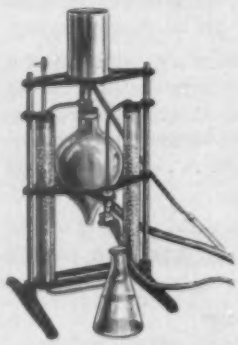
Pasadena 3, California

ENSLOW
Stability Indicator



For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

WRITE:

Phipps & Bird, Inc.
P. O. Box 2V Richmond 5, Va.

Literature & Catalogs

Valve Selection Chart

413

Automatic Switch Co., Orange, N.J., has available a selection chart on **ASCO Solenoid Valves.**

General information about the valves is featured on the front cover. The valve selection chart breaks the information down into 8 different general classes of valves, with specific details listed under the general types. Pipe sizes, maximum pressures, and various materials handled by the valves are also given.

Simplified Tunneling

414

Armco Drainage & Metal Products, Inc., Middletown, Ohio, has just published a bulletin entitled **"Why Throw a Road Block on Traffic and Business?"** It describes how tunneling is simplified by the use of Armco liner plates.

The bulletin tells how to avoid tearing up pavements and disrupting traffic when installing sewers and other underground structures.

Also contained in the bulletin are illustrations of various types of installations, including aggregate bins and conveyor tunnels, for which liner plates have been widely adapted. A table of physical properties concludes the bulletin.

Diesel Engine Booklet

415

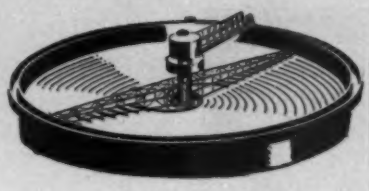
Murphy Diesel Company, Milwaukee, Wis., has just released a new 48-page booklet that gives detailed descriptions of engineering design features to look for in **Diesel Engines.** In addition, ratings and descriptions of Murphy Diesel models are presented. Nineteen pages of photographs of typical installations are also shown.

Heavy-Duty Float Switch

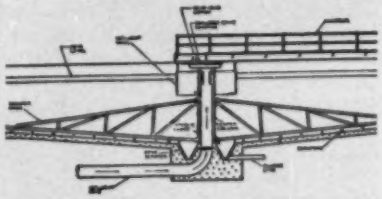
416

Healy-Ruff Company, St. Paul, Minnesota, has available a specification sheet on their **Type 151 All-Purpose, Heavy-Duty Float Switch.**

The sheet shows photographs of the switch and discusses the mechanical specifications, standard features, optional features and a set of typical specifications.



Center-Feed Center-Discharge Clarifiers



One reason for the efficiency of Hardinge Clarifiers is the fact that the influent goes directly to a central stilling well and the underflow also is centrally removed. This promotes quick disposal of the heavier solids immediately upon entry—makes less work for the rotating sludge scrapers. The clear effluent overflows the tank periphery, where velocity is at a minimum. Bulletin 35-C-15

HARDINGE
COMPANY, INCORPORATED
YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works
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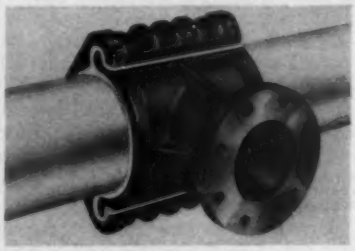
NOW!! the NEW BOLTLESS TAPPING SLEEVES



for CAST IRON PIPE
for CEMENT—ASBESTOS PIPE

Top economy in installation and maintenance because NO CAULKING NECESSARY—allows even unskilled workmen to do faster, better installations. LESS EXCAVATION and MORE WORKING AREA through new, simplified mounting process. Assured LIFE OF PIPE SERVICE.

QUALIFIED DEALERS AND DISTRIBUTORS WANTED IN KEY AREAS

Write for full information TODAY!

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3279 Verdugo Rd., Dept. 23
Los Angeles 65, Calif.

Inferential Meter

417

Simplex Valve and Meter Company, Philadelphia, Pa., has published a colorful and information-packed bulletin, describing the **Type MO Meter.** This 16-page bulletin contains data on operation, construction, accuracy, primary devices and other general information of interest to power, process and sanitation engineers who deal with fluid flow problems.

According to the bulletin the Type MO instrument is perhaps the most accurate Venturi type meter now available, and it provides a means of obtaining very accurate measurement of fluid flows over remarkably wide ranges and is designed for water, sewage, sludge and industrial liquors.

Available in the indicating, recording and totalizing form, it can be operated as a direct mechanical instrument or as an electric or pneumatic transmission device.

Cloroben Dosing Tank

418

Cloroben Corporation, Jersey City, N. J., has available a new folder on the **Up-Sewer Cloroben Dosing Tank.**

The 6-page folder describes in detail the principle of Cloroben controls, the method of application, and how to install the treatment tanks. A photograph and cut-away drawing shows how the tank operates and the method of refilling it. The back page gives some of the typical results obtained from using the treatment tanks.

Chlorinators

419

Everson Manufacturing Corp., Chicago, Ill., has available a booklet on **Sterelators** for the chlorination of water or sewage.

The booklet discusses the advantages of the Sterelators and photographs show various types of installations for both manual and semi-automatic operations. The center spread has two attractive flow charts depicting both operations.

Pipe and Pipe Fabrication

420

L. B. Foster Co., Pittsburgh, Pa., has just issued a catalog titled **"Pipe and Pipe Fabrication"** that lists spe-

(*Continued on page* 130A)

CEMENT GUN COMPANY RELINES SETTLING BASINS WITH GUNITE

Photograph above shows three of four Settling Basins at a Virginia City's Municipal Water Works during the course of being relined with "Gunite." The concrete in this structure had disintegrated considerably, due to chemical and frost action.

Cement Gun Company crews replaced a "Gunite" lining on the floor and on the exterior walls of the basins and, in addition, grouted under the floor of all four basins to solidify the structure.

Additional reinforcing of steel mesh and "Gunite" was added at all corners where failure was indicated by leakage and the presence of large cracks.

This is just one of many typical "Gunite" repair jobs which have been done. For information on "your job" and description of many other "Gunite" jobs, performed by us, send details and request catalog (C) 2400—on your letterhead, please.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.
MANUFACTURERS OF THE "CEMENT GUN"

ROTO-TROL 940

CONTROLS that are dignified by a background of long experience and infallible operation. ROTO-TROL 940 controls pumps, valves, alarm circuits, etc., from one float. Starting and stopping positions, rising and falling, can be set as required. Each circuit is independent. Mercury switches with snap action are used. ROTO-TROL 940 can be easily set on the job.

Write for Bulletins

Water Level Controls Division
HEALY-RUFF Company
783 HAMPDEN AVE., ST. PAUL 4, MINN.

INCREASE SEWAGE PLANT CAPACITY WITHOUT CAPITAL COST!

WHAT IS IT?
- BIONETIC is a dry powder of preserved beneficial groups of micro-organisms that accelerate natural biological action.

WHAT DOES IT DO?
- BIONETIC can save money on sewage plant problems including odor control, increased sludge digestion capacity, and scum blanket control.

INTERNATIONAL ACCEPTANCE:
- BIONETIC is successfully used by hundreds of municipalities, industries, resorts, and institutions.

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Reliance Chemicals CORPORATION
P. O. BOX 6724 HOUSTON 5, TEXAS

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

HYDRO-TITE

DEPENDABLE JOINTING COMPOUND

Seals Bell and Spigot Water Mains

Economical—Effective

Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.

MAIN SALES OFFICE 50 CHURCH ST., N. Y. C.

General offices and works W. Medford Sta., Boston, Mass.

WANTED

ASSISTANT FILTER PLANT SUPERINTENDENT. Under 45. Experienced in large filter plant operation and maintenance. Must be capable of handling electrical and mechanical maintenance. Should be licensed. Engineering degree desirable but not essential. Opportunity for advancement. Location—Northeast.

Write Box 1120

Water & Sewage Works
185 N. Wabash Ave.
Chicago 1, Illinois

ANTHRAFILT

Trade Mark Reg. U. S. Patent Office

A Filter Medium For All Purposes

ANTHRACITE EQUIPMENT CORP.

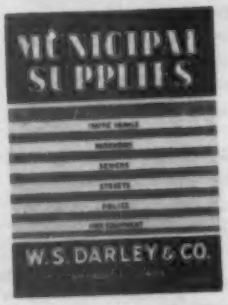
Anthracite Institute Building
Wilkes-Barre, Pa.

All correspondence regarding sales and engineering should be addressed to:

PALMER FILTER EQUIPMENT CO.

822 E. 8th St. Erie, Pa.

Engineers and Sales Agents



Write Today For 100 Page Catalog

W.S. DARLEY & CO., Chicago 12

(*Continued from page* 129A)

cifications for all sizes of pipe from ⅛ inch to 24 inches in diameter.

Tables giving data and description, wall thickness, weight, etc., cover all schedule pipe from Schedule 20 through Schedule 160, also standard, extra strong and double extra heavy pipe, spiralweld pipe, large O.D. pipe in all wall thicknesses, line pipe, electric-weld tubing, welding fittings and flanges, oil well casing and water well casing.

The 16-page, 8½ by 11-inch catalog also describes Foster's pipe fabrication facilities for structural uses, including portable docks, sewer inlets, fence posts, hand railings, stadium bleachers, racks, road signs, portable scaffolding, street lighting poles and sprayer supports.

Pressure Governor

421

Consolidated Electric Co., St. Paul, Minn., has available a bulletin on their **Induction Type Pressure Governor.**

The bulletin describes the governor as an instrument that provides accurate and dependable control of pumping equipment in water systems employing elevated reservoirs. The application, operation, selection and features of the governor are discussed and drawings showing range and differential, dimension, pipe and electrical connections are included.

Universal Nipple Chuck

422

Beaver Pipe Tools, Inc., Warren, Ohio, has recently produced a new envelope enclosure describing its new **Universal Nipple Chuck.** The folder stresses how easily short lengths of pipe can be converted into usable nipples by using this new unit.

Finished nipples are removed from the chuck by hand. No tools are required. The entire outfit, including several sized adapters, are packed in a convenient, easy-to-carry kit box. Sizes and prices are also presented.

The back page is devoted to Beaver's new Model-D Aluminum Power Drive. This new unit weighs about 100 pounds and is easily carried by one man.

Pipe Puller & Pusher

423

Trojan Manufacturing Company, Troy, Ohio, has available a 4-page folder on the **Trojan Pipe Puller & Pusher.**

The folder, by means of pictures and descriptive text, shows how these Trojans, with their continuous operation and double action, will cut in half the labor and job time. Operating instructions and a list of accessories are also included. Page 4 gives a partial list of water works departments now using the Trojan pipe puller and pusher.

Swimming Pool Supplies Catalog

424

Modern Swimming Pool Co., Inc., White Plains, N.Y., has available a reference catalog of **Swimming Pool Supplies, Chemicals and Equipment.** It is a 28-page book, profusely illustrated and full of data on everything needed to build a new swimming pool or to equip and maintain an existing pool.

The catalog gives illustrations and prices of all water treatment chemicals and supplies, all fittings and fixtures needed to build a new private or public swimming pool or to improve an existing swimming pool. It contains detailed information on such items as algae preventives, chlorine, water softeners and conditioners, swimming pool fittings,

pool ladders, chlorinators, underwater lights and vacuum cleaners, diving boards and stands—even special swimming pool paints. It illustrates every item a pool owner or builder could possibly want and gives complete information and prices on every product.

Golden Anniversary Clay Products Catalogue

425

The Kaul Clay Manufacturing Co., Toronto, Ohio, marking 50 years of growth and progress, has prepared a comprehensive 60-page **Golden Anniversary Catalogue** describing its complete line of vitrified clay pipe, fittings, flue lining, wall coping, septic tanks, liner plates, chimney tops, drain tile, brick and other clay products.

This completely illustrated catalogue, printed in three colors and spiral-bound in an attractive leatherette cover, contains complete dimensions and price lists.

Permutit Precipitator

426

The Permutit Company, New York, N. Y., has just released a well illustrated 20-page booklet describing the many applications, principles of operation, design features, advantages, recommendations, flow diagrams, and specifications of the **Permutit Precipitator** in its three basic designs.

According to the booklet, the Precipitator offers an efficient means of removing impurities from a liquid by precipitation, absorption, settling and filtration. The unit requires less space, less chemicals and less reaction time than previous designs. Chief uses are in water softening, the removal of turbidity, color, taste, odor, alkalinity, silica and fluorides.

Disc Feeder

427

Omega Machine Co., Providence, R. I. has announced a new bulletin on their **Model 50 Disc Feeder** for dry materials. This four page bulletin lists the advantages of the low rate feeder, and describes its operation, its feed range and its feeding mechanism. Additionally, it points out that the standard unit will feed practically any free flowing granular or powdered dry material. Accessories described include a disc unloader, hopper agitator, and portable platform scales.

The bulletin lists the following features of this Feeder: Continuous, Accurate Feeding; Micrometer Feed Gate Adjustment; Rugged, Compact Design; Low Filling Height; Visible Feeding and Low Cost.

Laboratory Apparatus

428

Labline, Inc., Chicago, Ill., has just completed a 92-page catalog on **Laboratory Apparatus.** The catalog illustrates and describes apparatus for research and control laboratories, such as, Constant Temperature Baths, Circulating Systems, Force-Aire Ovens 500° F., Industrial Ovens to 950° F., Radiant and Thermo-Wall Ovens, A.S.T.M. Petroleum Testing Apparatus, Incubators, Constant Temperature Rooms, Alumaloy Clamping Devices, Sectional Furniture, including 3-D Layout Kit, Heaters, Wet Test Meters and Calorimeters, Rota-Set Regulators and Electronic Relays and Stirrers.

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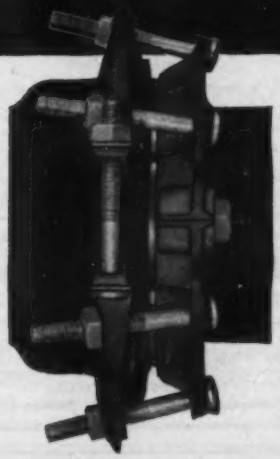

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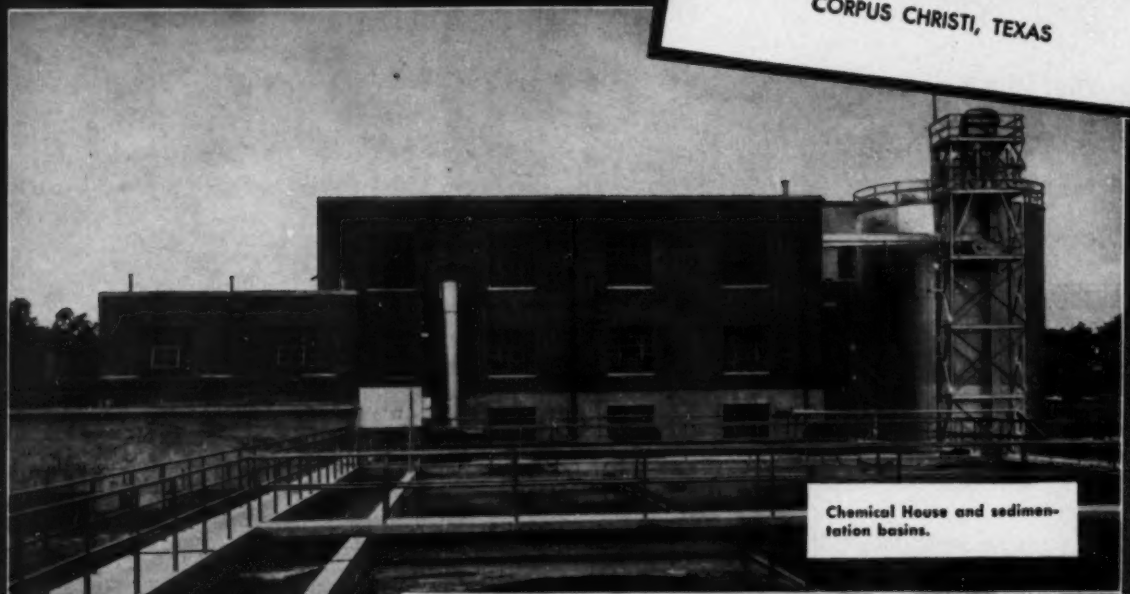

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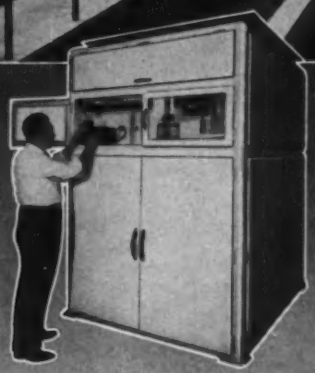

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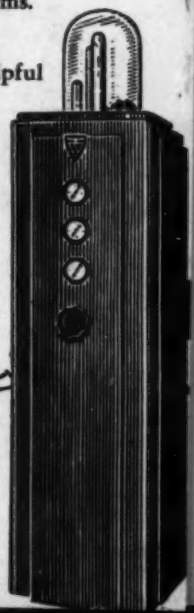

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